WARMING & VENTILATION.

Smead & Northcott,

Successors to

Northcott & Stine,

Elmira N.Y.

1886

VENTILATION

AND

WARMING OF BUILDINGS,

UPON THE PRINCIPLES AS DESIGNED AND PATENTED

BY

HON. HENRY RUTTAN,

IMPROVED AND PATENTED BY

B. R. HAWLEY and ISAAC D. SMEAD,

Now owned and controlled (under 13 patents),

BY

Ruttan-Smead Heating and Ventilating Company,
TOLEDO, OHIO.

Ruttan-Smead Warming and Ventilating Co.,
ELMIRA, NEW YORK.
(NORTHCOTT & STINE, NEW YORK AND NEW ENGLAND).

Ruttan-Smead Warming and Ventilating Co.,
ELMIRA, NEW YORK.
SMEAD, WILLS & CO., PENN., NEW JERSEY AND DELAWARE.

Ruttan Manufacturing Company,
CHICAGO, ILL.

Ruttan Ventilating and Heating Company,
KANSAS CITY, MO.

Successors to the firm of W. A. PENNELL & Co., Normal, Ill., original proprietors of the Ruttan System of Ventilation, for the United States.

NOTICE.—The only parties in the United States in any way interested in the "Ruttan System" of warming and ventilating, or in any improvements on the same, are the firms whose names appear below, and any others representing to introduce the "Ruttan" or "Ruttan-Smead," are imitators, and we caution the public against them.

RUTTAN VENTILATING AND HEATING ASSOCIATION

OF THE UNITED STATES.

CHICAGO, KANSAS CITY, TOLEDO, ELMIRA.

ISAAC D. SMEAD, President. OTIS JONES, Secretary. E. C. CONDIT, Treasurer.

S. D. FISHER, S. L. BAILEY, Consulting Engineers.

Ruttan Manufacturing Co., Chicago, Ill.

Ruttan Ventilating and Heating Co., Kansas City, Mo.

(E. C. CONDIT & CO., PROPRIETORS.)

Ruttan-Smead Heating and Ventilating Co., Toledo, Ohio.

(ISAAC D. SMEAD & CO., PROPRIETORS.)

Ruttan-Smead Warming and Ventilating Co., Elmira, N. Y.

NORTHCOTT & STINE, PROPRIETORS FOR NEW YORK & NEW ENGLAND.
SMEAD, WILLS & CO., PROPRIETORS FOR PENN., NEW JERSEY & DELAWARE.

SHEPARD & JOHNSTON, PRINTERS, 140-146 MONROE ST., CHICAGO.

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HISTORY OF THE RUTTAN-SMEAD SYSTEM

OF

WARMING AND VENTILATION.

BY ISAAC D. SMEAD,
WARMING AND VENTILATING ENGINEER.

IN 1862, the Hon. Henry Ruttan, of Coburg, Canada, after many years of patient experimenting and after reading almost everything that had been printed upon the question of warming and ventilation, published a large volume upon the subject, illustrating his theories by a number of diagrams.

In 1866, a copy of Mr. Ruttan's book fell into the hands of Mr. B. R. Hawley, of Normal, Illinois. Mr. Hawley was favorably impressed with the arguments therein contained, and at once determined to build a residence for himself and to introduce Mr. Ruttan's system of ventilation. After considerable correspondence, Mr. Ruttan, who was at that time nearly eighty years of age, came to Illinois from Canada, and Mr. Hawley, acting upon such suggestions as he made, constructed his residence for the system; *and this was the first building in the United States in which the Ruttan system was ever used.*

Mr. Hawley and his friends, who had become interested in reading Mr. Ruttan's book, were very much surprised to learn that this residence was the *first* that had ever been built in accordance with Mr. Ruttan's ideas. Mr. Ruttan had secured some patents in Canada and in the United States on his system of construction, and also had patented some ventilating stoves for use in small rooms and school buildings, but he had never had any experience in the business of warming and ventilating except from his experiments in a small way with these small heaters, and also some work in the direction of ventilating railroad cars.

The system as applied to the residence of Mr. Hawley was a failure, as was also the heating apparatus provided.

Mr. Hawley experimented with the apparatus in his residence for some time, making many changes, and with considerable success; and he finally became agent in the United States for the sale of Mr. Ruttan's stoves. The demand for them was limited, as they would only burn wood, while, especially in the West, the natural fuel was soft or bituminous coal.

At this date (1866) but little had been attempted by anyone toward improving the sanitary condition of our buildings; there were a few who, like Mr. Ruttan, had theories, but nowhere could be found a sanitary engineer who had *practical experience;* who could examine a building or a plan of a building, and say just what ought to be done to make it breathe and at the same time comfortably warm in the winter. Doctors had theories, architects had theories, writers were writing about what was *not* done, a few scientific books were before the public, but with the exception of Mr. Ruttan's they were so very scientific that they were of little use to the average reader: one would refer to the climate in England, and another to that in France, but as America had more climate than either (if I may be permitted to use the expression), we did not know what to do, and so hundreds and thousands of buildings were erected every year with no effort whatever

being made to ventilate them; our residences, schools and churches were made as tight as possible, and generally if flues were built to take air *into* them, none were built to take air *out;* or if ventilating flues were built to take air *out*, none were provided to take any in. If the school children were sick and died, the friends called it a "Dispensation of Providence," closed the school for a day to permit the others to attend the funeral, and then they were boxed up again in the same school room. If they came home with a headache, kind friends said that they were studying too hard; and most children were pleased with the statement, accompanied by a few days' vacation. This was the condition of affairs all over the country.

In 1866, Mr. Hawley associated with himself two other gentlemen, Mr. W. A. Pennell, of Normal, Illinois, and Mr. Lemuel Grover, of Bloomington, Illinois, and together they commenced to improve Mr. Ruttan's system of construction, for it must be remembered that Mr. Ruttan, like all others, had only a *theory;* his entire publication was an argument in favor of constructing with a building, large, cold and warm air flues to take air into the house, and large flues to take air out of the house; and that all exits for foul air should be made at the *bottom* of the room instead of at the *top*, as was then the custom, and each room be supplied with warm air from a central chamber, as, for instance, the corridor of the building. He did not seem to be at all familiar with the construction of large buildings or he would easily have understood that his methods would not be at all practical in, for instance, a school building of two or more stories.

Many readers of this who have become familiar with the much talked of "Ruttan System" will be surprised to learn that, with the exception of the residence of Mr. Hawley, *Mr. Ruttan never had anything to do with the warming of a building containing more than one story, and* that he says in his book that he does "*not really know how to ventilate the second story of a residence.*"

This was the condition of the system when Messrs. W. A. Pennell & Co., with office at Normal, Illinois, commenced their work. All they had to guide them was a few theories advanced by Ruttan, and no member of the firm had ever had an hour's experience in the business of warming, ventilating, architecture or building; and only one of them experience in manufacturing, one of the other two being a retired merchant, and the third a sanguine, impractical inventor. The firm purchased from Mr. Ruttan such patents as he had, a few stove patterns and the right to use his name. Their idea being to furnish plans and specifications and collect a royalty for the use of the patents. *It was not their intention to manufacture a heating apparatus of any kind, except perhaps the ventilating stoves.*

Greater experience, or as it now seems the exercise of a little more common sense, would have shown them that if large cold air conduits were provided to take the air *into* a building, and large ventilating stacks were erected to take the air *out* of a building that large heating surface must be provided to warm the air before passing into the rooms. But this important point the very key-note of the success of the system as now—1885—introduced was overlooked, and as a result, in every instance where their plans were followed they were pronounced a failure, and those originally opposed were pleased, their customers displeased and the firm caused embarrassment and loss. At that date (1866) there were six methods of warming in use, namely, the open fireplace, stoves, hot air furnaces, steam and warm water. Manufacturers of all these appliances were very happy because the "new system" had so completely failed to meet the guarantees of the somewhat visionary owners and advertisers. But with firm faith in the correctness of some of the principles argued for by Mr. Ruttan, the company acknowledged their defeat and commenced again. At that time all, or nearly all, the heating appliances used were manufactured in the East and all made to consume hard coal or wood; very little attention having ever been given to the consumption of soft coal, the natural fuel of the West.

Great effort was made by Pennell & Co. to find some apparatus that had sufficient amount of fire surface to warm the volume of air required; the search was unsuccessful and they determined to build an Air Warmer to meet the new demand. The situation is well illustrated in the experience of those who first used steam as a power; previous to that date a common kettle was sufficient to boil all the water required, but as soon as steam was wanted in large quantities, and

quickly, the kettle would not answer; a new and better apparatus was needed and must be provided, and as "necessity is the mother of invention," the inventive genius of the age gave to the world the tubular boiler. This could furnish more steam simply because it presented to the water to be boiled more fire surface to warm it. This is the secret and one easy to comprehend now; but if the reader knew the history of its growth and the trials of the inventors and the manufacturers, he would learn a story that he would not soon forget. All furnaces were as valuable for the purpose required by Pennell & Co., as was the old kettle to the steam-power men, and the fact was a plain one that a new warming apparatus must be made, but how to make it, or of what size it should be, or what material should be used, who could tell them? The books could not; no two *theorists* could agree; the manufacturers were busy doing all in their power to advertise the fact that Mr. Ruttan's theory was wrong and that Pennell & Co. were a set of "cranks," and that the large ventilating flues (not very handsome as built then, and in some cases too large, I will admit) were "factory stacks," "cold air ducts too large," etc., etc.,

It was very clear to Pennell & Co. that they must either abandon the entire business or make an apparatus in which they could use either soft coal or wood, and that had a heating capacity sufficient to warm the volume of air required. They determined to do the latter, but could they have foreseen the losses, the defeats, the large amount of money required, the many years of hard work before they should meet with any degree of success, the reader may be assured that they would never have commenced, and that the millions of pounds of iron now manufactured yearly by the Ruttan Warming and Ventilation Association into Ruttan-Smead Heating and Ventilating Apparatus would be made into some other kind of goods, and the large force of men employed in their manufacture would be obliged to seek employment in some other field of labor. It must be remembered that this firm had little to guide them, and could not *copy*, as most other manufacturers do.

As an example of this habit of copying, we represent on other pages (pages 58 and 59) a large number of furnaces of different makes. It will be seen at a glance that they *are all substantially the same*, namely, a firepot and a dome, and if space would permit I could add a *hundred more, and the comparison would be unchanged.*

One manufacturer calls his a "Fire King," another "The Commander"; "Prairie Queen" is the name of a third, and "Peacemaker" is also on the list.

It always seemed to the writer that the name of a heating apparatus, or of any other machine, should, to some extent at least, explain the style or object of the designer; otherwise it would be as well to name them "Hannah," "Jane," or "Maria," "Tom," "Dick" or "Harry."

Messrs. Pennell & Co. were the first who were *forced* to make a heating apparatus; *all others were then and are now made by stove manufacturers simply as an incident to their general trade, or in machine shops, as a minor part of their trade;* they were sold to hardware dealers, stove dealers, or to any one who wished to buy. They were placed in cellars, and generally failed to warm the building over them; and as a result there was a wide-spread dissatisfaction, and "furnace men" were really considered "an evil," not at all "necessary," and to a very considerable extent the work done at this date is no better than the work done by the "hot air" furnace dealers of twenty years ago. As a general thing, the only interest the salesman has in the contract is the commission he gets for making the sale. I know of many localities where the 'furnace man," the "lightning-rod man," and the "book agent" are all placed in the same class, and when I examined the work that some of them do I am not surprised at the classification. Pennell & Co. had advertised this system of construction as one that would insure ventilation, and had unwisely attached themselves to the furnace fraternity by using, in connection therewith, about all the kinds of furnaces made, and, as before stated, had almost entirely failed; they saw that neither the "Fire King" nor the "Hot Blast" would be a "Peacemaker" between their customers and themselves, and that the "Prairie Queen" would never become a ruler; that they must have an "Air Warmer," some sort of an apparatus that would take a large volume of cold air and warm it, while all others, owing to the lack of fire surface, could only take a small volume

and heat it very hot, converting into cinder all the dust and organic matter the air contained, and rendering it unfit for breathing.

I have referred to the warming of water for the generation of steam and to the tubular boiler as compared with a kettle; the reason why the boiler will warm more water is because of its greater amount of fire surface. Pennell & Co. determined to make an air warmer that should, to some extent, duplicate the boiler or *water warmer*, and selected *wrought iron* as the material to be used. The sanguine member could see "millions" in the idea while the plan was on paper, and much against the wishes of his partners, ordered nearly a hundred to be made, costing many thousand dollars.

Unfortunately, the first one finished was sold to a party who used wood for fuel, and, like the old fashioned sheet-iron stove, the furnace was soon ready for "business," and could quickly furnish a very large volume of warm air. They immediately put about sixty into schools buildings, churches and residences, in the states of Illinois, Iowa and Michigan, and at least nine out of ten were required to burn coal (bituminous). Of course no fires were built until fall, and then the reader can be assured that "trouble commenced." Pennell & Co. had guaranteed the warming and ventilating, and of course there was an *implied* guarantee at least as to durability. Many of the air warmers did not last a month; they seemed to tire of life, and would sit right down with a terribly discouraged appearance, and it did almost discourage the firm, and the customers were not only discouraged, but *mad*; schools were dismissed because of cold school rooms, sermons were half preached and to small congregations; church and school trustees seemed to spend about half their time either in sending telegrams or writing letters to the firm that had sold them such a short-lived apparatus, while owners of residences bought a few stoves and cautioned their neighbors against buying any kind of a heating apparatus except stoves. Manufacturers of the steam appliances and the old hot air furnaces were happy of course, for occasionally a furnace would (and generally by accident), be so set that it did warm the rooms, even if it did not ventilate them, and their owners praised them, as they would rather be poisoned a little and be *warm* than to be *frozen* trying to keep the bad air from the rooms. It is easily seen that this was a terrible back-set to the Ruttan system, and a great loss to its owners as well as a humiliation to its friends. Two things, however, had been demonstrated: 1st. That there was a system of construction to secure ventilation that could be relied upon; 2nd. That a machine or air warmer could be designed that would warm the volume of air required. The work now before them was to make the apparatus durable, and to so construct it that *soft coal* might be used. The sanguine member of the firm retired; the one best posted in mechanical matters commenced the manufacture of patterns for a *cast-iron air-warmer*. After months of work, and the expenditure of a large sum of money, three sizes were ready for use. A heating apparatus cannot be thoroughly tested except in cold weather, and the winter was looked forward to with no little anxiety. Upon trial it was found that although the cast-iron furnaces were more durable than the wrought-iron ones, there was a new trouble to contend with, namely, the smoke and gas from the soft coal rendered them about as much of a nuisance as were the old wrought heaters, and thus another winter was lost and the Ruttan system was still almost a failure. Of course, to its friends, the defects were not so great that they did not expect to overcome them. Another assessment was made, new patterns were manufactured, and in the spring of 1869 the firm commenced to do their first good work; the winter of 1869–70 was the first since the introduction of their system that they could point to a single job of warming and ventilating that had been entirely satisfactory, either to the customer or to the owners and friends of the system. But with the reputation the previous winters had given there was little to hope for; other firms had not neglected to advertise our failure; as to the success of the winter just passed they claimed that the work would not stand the test of time, and to some extent their statements were true. Considerable work was done during the years of 1870–71, and in May, 1872, a new firm was organized: The Ruttan Heating and Ventilating Company of Bloomington, Illinois; W. A. Pennell, President; Isaac D. Smead, Secretary, and S. D. Fisher, Superintendent; Messrs. Pennell and Smead had been connected with the business from the first, the latter as an office

employé. The company at once commenced to push the system with all the ability they possessed; several thousand dollars were expended to improve old patterns and to make new ones. For five years the company expended almost every dollar of the earnings in developing, advertising and extending the business; several hundred buildings were provided with a system of warming and ventilating that was, without doubt (and I say this without the least feeling of egotism), *the best on earth at that time;* hundreds and thousands of friends were made; *steam heating apparatus, hot air furnaces, and stoves were removed by the score and ours introduced.* Such was our opportunity to experiment, as our work was scattered over a half-dozen states (although confined mostly to public buildings) that we learned about all the requirements of a successful apparatus, and how it should be introduced. At the end of four years scarcely a pattern remained that was in use when the firm was organized in 1872. *The question of fire surface*, of *durability*, of *size and location*, of *warm and cold air flues, had been settled*, and in fact almost everything had been settled except the payment to the firm of the large amount of money they had invested. The "times" had been growing "harder" for years, and yet, but for an unfortunate investment in several thousand dollars' worth of poor iron the company would have pulled through their financial troubles; but in the spring of 1877 they were forced to suspend, and it again seemed as if the years of labor and toil were to be lost completely. Competing firms, or firms that had tried with their "Hot Air Appliances" to compete, tried to effect a combination to control such patents as we had, and also to secure the property that had been accumulated; but friends stepped in, and a new company was organized under the name of the "Ruttan Manufacturing Company," Isaac D. Smead, President; E. C. Condit, Secretary; S. D. Fisher, Superintendent, and Otis Jones, Treasurer. Of the persons mentioned, two, Messrs. Fisher and Smead, were experienced engineers in the so-called "Ruttan System;" the other members were new to the business. I say "So-called Ruttan System," because all the work had been done under the name of Ruttan, although there was even at that date very little that Mr. Ruttan would have recognized as a part of his system could he have been called back from that "other world." The offices of the company were removed to Chicago, and once more the business was started.

After two years of business success in Chicago, a new office was opened in Kansas City under the name of the Ruttan Ventilating and Heating Company, with the firm of E. C. Condit & Co. as proprietors. Mr. Condit having resigned his position with the Ruttan Manufacturing Co., he was succeeded as an official in that company by Mr. W. B. Titus. Two years later the territory was again subdivided; a new office being established at Toledo, Ohio, under the name of the "Ruttan Heating and Ventilating Co., Isaac D. Smead & Co., Proprietors;" Messrs. Smead and Titus resigning their positions in the Ruttan Manufacturing Co., the former after almost fifteen years of constant service.

In 1877 the amount of iron manufactured into Ruttan apparatus amounted to about 200,000 pounds, and in *1884 to over 3,000,000 pounds.* Hundreds of public buildings have been warmed and ventilated by the apparatus manufactured by this association of firms, all operating under the name of Ruttan; although there has not been a Ruttan patent alive for years, nor has there been a casting used that would be recognized by Mr. Ruttan were he alive. Thousands and thousands of dollars have been expended to improve the apparatus and to advertise the system.

Under the agreements that bind the firms together a patent secured by one, either by purchase or grant, is owned by the other firms in their respective territories. It will be thus seen that a customer in Massachusetts purchasing of the firm to whose territory that State belongs, receives the benefit of all the improvements that may originate in all the offices of the association, whether Kansas City, Chicago, Toledo or Elmira.

In 1885, two more firms were organized, the members being from the force of Isaac D. Smead & Co., at Toledo; Messrs. Northcott & Stine, and Smead, Wills & Co., with offices at Elmira, N. Y., under the name of "Ruttan-Smead Warming & Ventilating Co.," the former having as their territory New York State and New England; the latter having New Jersey Pennsylvania and Delaware. The name "Ruttan-Smead" was selected by these parties (and allowed to be used after several months refusal by the writer), because it was claimed by them

that the engineering ability and great experience of Mr. Smead had had more to do with the creation and perfection of the system than ever Mr. Ruttan had; and also because there were several manufacturers who claimed, and still claim, to furnish "Ruttan, or any other system desired" (a compliment to their modesty, honesty and ability!); and also because they thought it due to the public that the name of a live man be added to that of the originator, who, were he alive, would fail to recognize the system that bears his name as it is now applied.

The writer of this has been connected with the work since its commencement and gives this long detailed history of the Ruttan System for several reasons:

1. That the readers may be familiar with the story of the "Ruttan System," and understand why we use the name Ruttan as our trade-mark, and may not be misled by those who formerly ridiculed, but who now *try to imitate and counterfeit the work of the engineers who for years labored to fully understand and apply the principles* first brought before the public by Henry Ruttan; for no matter what theories other writers may advance, or how many there may be to dispute them today, the principles first advocated by Mr. Ruttan are the ones that *must* be followed wherever any degree of success is obtained.

2. To call attention to the fact that there has grown up with this system a force of experienced sanitary and practical engineers; men who have designed, introduced and guaranteed a system of warming and ventilating, and in many instances left thousands of dollars to be paid them after entire winters' trials had demonstrated the truthfulness of their statements and the correctness of their designs.

3. I wish to show the reader, that although Ruttan is entitled to great credit for suggesting a certain system of construction, that not he, but others have had to *improve, develop, perfect* and to advertise and work for years to get before the public *a system now universally acknowledged* to be of incalculable benefit to more than *one million* school children, as applied by us in school buildings alone.

4. This explanation is made that the reader may fully understand why the system is, even now, called "a failure" by some who only knew of it in its infancy, for there are those who never hear of anything more than once; and there are still others who, seeming to be of the opinion that if they do not *condemn*, others will assume that they are not wise; they are living examples of the truthfulness of the saying that "a little knowledge is a dangerous thing."

5. To answer, as best I could, the very unjust, unfair and incorrect statements of a writer who published a book in 1884 upon the subject of ventilation, and who, in its "Table of Contents," informs the seeker after light that he can learn about "Ruttan's System" on page 77; and upon examination of the chapter to which he is referred, the reader will learn all the writer of the book knows about a system on which more than $100,000 had been expended to perfect, and of a company bearing the name of "Ruttan" and giving employment to over 300 men, and in which nearly a quarter of a million of dollars are invested. All he knows about it is expressed in the following, which I quote verbatim from his valuable (?) addition to the literature of our age: "I have been told that along our Northern frontier and in Canada, a number of private houses were built on this plan about fifteen or twenty years ago, but I have not been able to obtain any particulars as to the result."

Is the reader surprised then that the writer of this, who, it must be distinctly understood, makes no claim to literary ability, after reading the foregoing abstract from "——— on Ventilation," should at once determine to tell the *true story* of "The Ruttan System," and, so far as possible, defend the name and protect the interests of the association which has so large a pecuniary interest at stake, and with which he has been associated since boyhood?

I do not propose to furnish additional literature that is so largely scientific that the average reader cannot comprehend it or judge as to whether the matter presented is reasonably true. During the past fifteen years I have designed more plans providing for the warming and ventilating of both public and private buildings than any other man in America, and contracted to introduce the warming and ventilating apparatus, guaranteeing its successful operation, leaving in the

hands of the customers more than a quarter of a million of dollars to be paid after trial; and there has not been one dollar in *ten thousand* of that amount that has not been paid cheerfully.

As I have been identified with the "Ruttan System" since its first introduction, and so closely identified that by many it is now called the "Ruttan-Smead System," as I have been thoroughly familiar with all kinds of heating apparatus manufactured or sold during the past twenty years, and been in more than two hundred contests before boards of education and other legislative bodies, where the closest and most careful examination has been made into every detail, and have been unsuccessful in securing the contracts in *less than two per cent* of the awards made; as I have been granted a large number of patents on warming and ventilating apparatus, and also patents on improvements in the construction of buildings to secure better ventilation; as I have worked in every department of the business, from the setting of the apparatus in the basements of the buildings to the managing of the offices with which I have been connected, (Bloomington, Chicago and Toledo) and by a unanimous vote made the chief executive officer of the Ruttan Ventilating and Heating Association; as I have executed contract after contract for years in succession for the same executive bodies, as for instance for the Board of Education of Toledo, sixteen school buildings, fourteen school buildings for the District Commissioners of Washington, D. C., three state normal school buildings for the State Board of Regents of Wisconsin, four school buildings for the School Board of Youngstown, O., and a score of other similar cases I could mention, and among them several of the largest, in the line of furnace contracts, by many thousand dollars, of any ever awarded in America (and never because I was merely the lowest bidder) but only after investigations, lasting in some cases for months, by careful, honest and competent officers who were trusted by their fellow citizens to attend to the construction of their public buildings; in view of those and many other facts of a similar nature, and, as before stated, in defense of the truth and the interests involved, I have decided, to the extent of my ability, to present on the pages of this book, which to no inconsiderable extent is published to advertise our business, the *plain facts* concerning the warming and ventilating of the buildings, especially those in which we confine our school children during the years which they attend school—I assume that possibly I can interest if I cannot instruct.

I shall present for the consideration of the reader, various reports of committees who have investigated and expressed their conclusions. There are a few points, however, to which I wish to call attention, and these are, that these reports refer to buildings examined by those who were *unprejudiced and who desired to state the facts*, and who were in no way interested in furnishing a testimonial to the manufacturer. Take, as an illustration of this, the East Saginaw report on page 53. This report was made by a committee who, when appointed, *were prejudiced against furnaces of any kind*, and also much dissatisfied with steam warming apparatus as introduced in their schools, and were exceedingly anxious to secure the best, if it was possible for them to find it.

There is no warming and ventilating apparatus with which I am familiar that has "brains;" I have never seen one that will run alone; they all require care and fuel. It often happens that after a committee has taken great pains to secure the best apparatus and to get it properly introduced and properly cared for during their term of office, their successors come in "for political reasons," knowing little of what has been done by their faithful predecessors, and often caring less. This is especially true in the larger cities where with "an indifference born of political life," some good worker who, during election campaign, has done valuable service, as a reward is given a position as janitor, although, possibly, he has never seen a furnace in operation until he builds the first fire in the apparatus he is employed to run. What master mechanic would employ an engineer who had never had experience on a locomotive? Who would employ a doctor that had never studied medicine? Who would engage the services of an attorney that had never opened a law book? Yet every year, warming and ventilating apparatus costing thousands of dollars is placed in the hands of men entirely without experience or interest in its care. This is one of the most discouraging features of the entire business. I have gone into

basements containing apparatus for which we had been paid thousands of dollars, climbed over piles of ashes dumped wherever most convenient, finding *cold air ducts closed*, that should always, during occupancy of building, be *open*, found the apparatus in the hands of an ignorant, lazy fellow, who had been employed by the board, sometimes because he was "a cousin" or "an uncle" of some one, or simply because he could secure employment from no other parties. Can any one wonder because an apparatus should fail under such management. The men who, in their capacities as trustees, employ him to care for public property costing thousands would not trust him with the care of a hundred dollar horse—if the horse were their own. And it is for this reason that I wish to call attention to the fact, that it is not always just or fair to wholly depend on what may be said concerning an apparatus unless it is known that the parties expressing opinions *are competent to judge* and *are familiar with the facts*.* Some people always want what they do not have; if they have a Singer sewing machine they want a Wheeler & Wilson. Why, they cannot tell. Some farmers who own a Buckeye reaper want a McCormick. Why, they do not know; they simply want it, and do not know enough about either to name a half dozen of the many castings that are required to make the machine. I mention these illustrations to call attention to the necessity of a careful examination and investigation of the merits of the claims made by each manufacturer, and a *comparison of the principles involved*, for if *they* are true and correctly applied they are *right*, no matter what any one may *say* about them.

All the claims made for the Ruttan-Smead System of warming and ventilating are very easily understood if carefully examined; and yet there are some who are *ready to condemn simply because they are too lazy to investigate*, or for the reason that they are interested in some other apparatus or experiment. I have met principals of schools who did not know whether their buildings were warmed by *furnaces* or steam apparatus; "guessed neither were used, only registers;" and others who, when I complained of the lack of cleanliness in the basement, remarked that they were "teachers, not janitors," and that they had "never been in the basement;" and "were not paid for giving attention to janitor's duties;" and yet at some "Teacher's Association" they would read a long essay upon some wild theory which the press may copy, and the people may call its author wise. They look pale and complain of "overwork," and try to look "all worn out," and unlike the hard worked business man of fifty-two weeks per year, must have a vacation—about three months out of every twelve. What a *rest* that would give some of us who are engaged in business! A rest, I fear, a healthy condition of our bank accounts would not permit.

The reports from which I quote do not furnish any literature from these poor "overworked," "tired out" chronic grumblers.

These reports herein contained are written by *live men;* men who will never be "tired" until they are through with life's work; and the world is now and will always be much better for their having been in it. For I honestly believe that those who aid in the improvement of the sanitary condition of our buildings are, and to no small extent, public benefactors.

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*See report of Bowling Green, Ohio, committee on page 49.

WHY THERE ARE SO MANY FAILURES IN WARMING AND VENTILATION OF BUILDINGS.

THE publication of circulars upon the subject of warming and ventilation has become very common, and many theories are advanced by parties who have never had experience in the practical application of *any system*, and who can guarantee nothing. Architects, doctors, divines, stove companies, stove dealers, hardware men, and in fact there are among all classes those who have their pet plans and theories; but there are very few who have had actual experience in the business—at least, when they have been held financially responsible for the successful warming and ventilation of the building in which they experiment. Their theories sometimes are attractive, but no beauty on paper can compensate for a failure in their practical working when cold weather comes; and as the plans they recommend are accompanied by no security against loss in case of failure, the party building, finds, when it is too late, that they are wholly without that which they are so anxious to secure—a good warming and ventilating apparatus—and can only make good the defect by a heavy outlay of money. We can refer to hundreds of buildings in proof of the above, where the owners have *discarded their plans* and *thrown out their apparatus*, and introduced the Ruttan-Smead apparatus, the expense incident to the change causing *large expenditures of money that could have been saved.*

The experimenters referred to, generally, lose sight of the buildings when completed, and are not aware of the blunders committed, but continue to recommend the same; while those who suffer for want of warmth and ventilation either condemn *all systems* or incur the expense necessary to correct their mistake.

To illustrate: We were recently called before a board of education to explain the Ruttan-Smead system with our improvements. A dozen plans had been submitted for a $40,000 schoolhouse, and of the lot *only one* was properly arranged for warming and ventilation; and of the half-dozen or more architects present, but *one* had ever had experience in applying a complete system of warming and ventilation; and yet the others were ready, and seemingly anxious, to argue against our experience in more than one thousand buildings. In a conversation with one of them, after adjournment, he remarked that "*although the plan submitted by you is the only complete and sensible system I have ever seen, yet it will not answer for me to acknowledge it before the board, as the design I have submitted for their consideration calls for the old-fashioned arrangement of tin pipes and small flues.*" We refer to this to show the necessity of placing these matters in the hands of parties who will *guarantee and become responsible for the success of the plans they submit;* and although we do not expect entire immunity from criticism (especially from old fogies), such has been the lengthened period of time which has elapsed since the managers of the Ruttan Company first commenced to operate with this system, and so varied have been our opportunities to apply it to all classes of buildings, that we do not hesitate to assert our ability to do better work than any with whom we compete. We are the only firms in the United States who devote their *entire attention to the warming and ventilation of buildings*, and can point with pride to hundreds of the largest public buildings throughout the United States which are warmed and ventilated by our system and apparatus. There can be but one *popular* system of warming and ventilation, and that must be the *natural*. In 1862, in discussing the matter, the Hon. Henry Ruttan said:

"Volume upon volume has been written, theory upon theory has been started, diagram upon diagram has been published, to show the different operations of air under different circumstances; and experiments

without number have been made on the two subjects of ventilation and warming, each writer and experimenter attempting to reconcile the general principles of philosophy to his *own particular theory*, instead of working out his theory by the *unerring principles of philosophy*. Any system, to be philosophical, must be universal in its application. Without this universality, it must fall to the ground; and when we hear of Dr. Reid's system, and Dr. Wyman's system, and a host of others who have written upon this subject, each advancing ideas perhaps differing from the others, no clearer proof need be adduced, that this great subject has never yet attained to the dignity of a system at all. It is a mere patching up of a piece of machinery by the stray wheels and component parts of several other pieces of machinery, in order to produce a desired result, but which, if we may judge by the progress of ventilation thus far, has ended in such a want of harmony in its working, as to leave the whole subject, for all practical and useful purposes, very much in the same state that it was in the beginning.

"The construction of an efficient system of warming and ventilation requires that all the details pertaining to it should be reduced to one *harmonious whole*, which shall be applicable to everything. If not good in all cases, it is good for nothing. It must be adaptable to the palace and the cottage, to the ship and to the railway carriage, to the habitations of animals as well as those of men, and in addition, it must be attainable by the poor as well as the rich."

General James Bintliff, of Wisconsin State Board of Health, in the annual report of 1877, says:

"Enough has been said to challenge attention to the cardinal differences of opinion which obtain among able, talented and experienced men; and it is impossible, in the brief space at our disposal, to state extensively the details of their opposing views. *Unfortunately it is too evident that the rank and file of so-called ventilators know little of the important service on which they depend for profitable employment.* Here and there an operator may be found with a conscience in his work, and appreciable rules for the direction of his labors and the apportionment of his machinery. But in a majority of instances in which we have songht to obtain information from men of that class we have been met by blank incapacity, allied with empirical assurance embodied in assertions that no rules were required, that guess work would do, that it made no difference how many persons were to be supplied with pure air, and with like silly statements which most painfully illustrate the fact, that in matters of ventilation as in many others, *the public are being misled and ditched by blind leaders of the blind.*"

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"The other side (Ruttan), with all the energy of deep conviction, resolutely affirm that the inlet ducts must be sufficiently large to flow every apartment with pure warm air, so that in the event of a window being temporarily opened, the pressure of atmosphere shall be from within outwards, the rooms literally overflowing with desirable atmosphere. Failing in this condition, it is claimed as the result of many years' experience, that the discharge ducts will necessarily, under unfavorable circumstances, reverse their operations, becoming supply pipes to fill the semi-vacuum which the other scheme always tends to produce.

"Professional acumen must eventually be the main hope of the community, because it is impossible to apply to every building the plans which may in some instances be found effective; and nothing less than thorough scientific training, alied with practical experience, will enable the operator to determine where and to what extent the normal conditions vary, so as to render radical changes inevitable."

Our statements are based upon *actual experience*. We are not architects or builders. We do not pretend to give advice regarding buildings on points other than those pertaining to warmth and ventilation. We are manufacturers of apparatus designed to accompany the *natural system*, and which was an outgrowth of its demands, and we give *personal attention* to the fulfillment of every contract awarded us, and *guarantee success*.

FURNACES, CONSTRUCTION, ENGINEERING, ETC.

ONE of the first questions to be considered by almost every one contemplating the construction of a building, or in securing apparatus to warm an old one, is the question of *cost*—cost of apparatus, cost of fuel required to be consumed, cost of janitor to care for the apparatus, and cost of repairs. Now, these are all items of no small consideration, and are questions, to every one of which the engineers of the Ruttan Ventilating and Heating Association have given a great amount of time and attention. The four points named above are the important ones that require careful attention from every one contemplating the purchase of warming and ventilating apparatus; and in presenting our arguments in favor of the system which we call the Ruttan-Smead System, we sincerely trust the reader will not assume that our conclusions are reached because of our desire to make a case for our apparatus. We hope others will carefully go over the questions as we have done, and am confident that they will agree with us that we have succeeded in at least establishing a *reasonable* theory. We shall illustrate, as far as is possible, most of our arguments by the introduction of a large number of cuts, and the explanations must be carefully examined that the cuts may be thoroughly understood. On the question of economy of fuel, we assume that our tubular masonry air-warmer, represented on page 60, is constructed upon the only plan that can be followed and the best results be obtained. Why? In answer, let us call the attention of the reader to the lithograph on page 33, representing an open fire. Now it must be apparent to any thinking person that a very large portion of the heat consumed by the burning fuel is lost up the flue so closely connected with the body of burning fuel. There is no argument on this—any one will admit the claim. Is it not plain, then, that to economize fuel, *we must hold on to the smoke and blaze, and other heated products of combustion as long as possible before they are permitted to escape up the smoke flue?* Of course it is, and we have many times told prospective customers that if other parties urged for their purchase an apparatus that retained the smoke, blaze, etc., longer than did ours, that was the one for them to buy, and we say so now. Two things are absolutely essential to the economical warming of air, namely: a properly constructed air warmer, and some method of *circulation* that will rapidly carry away the air from the apparatus that warms it. Probably the *cheapest* way to simply *warm* a room *would be to build the fire on the floor*, for then all the heat generated would certainly be contained in the room; but as it would be impossible for any one to remain in the room containing an open fire of this kind, the next best thing to do, provided both warming and ventilation are required, would be to cut a hole in the floor, build the fire in a box, put the box in the cellar, surround the box with an air chamber, connect this air chamber with the room by means of a pipe or flue, and also connect the air chamber with the outside air by means of another pipe or flue, build a flue in connection with the room that shall permit the cold air to go out as the warm air comes in, and, assuming that the box, or air warmer, in the air chamber, is properly constructed, and flues for cold air supply, warm air exit, and for ventilation, are of proper size, and you will then have an apparatus that will, with the *least possible expense for fuel*, secure not only the thorough warming, but the ventilation as well. You will also have an apparatus that will require the least amount of care, as there are but two things to be done, namely: put in the fuel and take out the ashes. If there is more than one room to warm, connect it with the warm air chamber, and provide a ventilating flue, and both rooms are warmed and ventilated from one fire, and with little care. Now, what can be more simple than the plan described? If properly done, the results are always the same

for the sueeess depends upon the operation of a *natural law*, a law established long before the *theories* of any writer on the snbject, or any manufaeturer ever sold a heating apparatus. We have no donbt but every reader will at once say that they can easily nnderstand the plan; many will say that they knew all that before, and would like to have ns state exactly the size they shonld build the cold air flne, the air warmer, the air ehamber, the warm air conduits, and the ventilating flue. This is just what we shall *not* do, and for several reasons.

1. Beeause, although what we have called "the Ruttan-Smead System" rests on a few simple principles (and when any one is found contradicting these prineiples he merely makes himself conspieuous by his ignorance); as no two buildings are ever exactly alike, its application continually varies. *Each individual case requires careful study.* An overdose of ventilation may be as bad as an underdose. While too slow a change of air will eause a room to beeome close, ill-smelling, and filled with earbonic aeid and other gases injurious to life, too rapid a ehange will cause unpleasant and sometimes dangerous currents of air.

A competent engineer will take into account not only the internal arrangement of a building, but also the kind and quality of floors, eeilings, windows, walls, etc., as well as construction of roof and the height of neighboring buildings. Variation in volnme as caused by temperature; in velocity as caused by height and temperature: perceentage of moisture and the various gases in the atmosphere mnst also be eonsidered, and the snccessful application of the Ruttan-Smead System depends, to some extent, upon each one of these things being correctly estimated.

For almost twenty years the members of this Association, have been steadily laboring to bring this, *the only natural system* into general nse, and have accordingly made a thorongh and long-continued study of every point pertaining to the science and art, if we may so call it, of ventilation and warming.

2. Because it is a part of our business to furnish plans and specifications wherever called upon to do so, and for which we expect remnneration. Is it easy? *Yes, if one knows how.*

The application of the system to publie buildings differing in size, height, constrnction, etc., reqnires engineers of edneation and years of experience on this particular snbject. It is no more a proper field for the clumsy attempts of inexperienced theorists, tinners, stove dealers and plumbers, than a city hospital would be for a druggist, a quaek or others with untried theories. The average architect knows no more abont the details of a complete plan of warming and ventilation than the writer does about "the man in the moon." It is a erime to permit experiments in such eases where other methods have proven safe. *When human health and life are at stake the best is never too good nor too expensive.* It is a very strange faet that members of Boards of Edneation and others in like position will sometimes deeide snch matters by awarding eontracts for ventilation and warming apparatus to the *lowest bidder*, and *although our prices are never more than enough to cover a reasonable profit, we always refuse to present an estimate if imformed that the fact of a bid being "low" will aid the one tendering it.* It must be evident to any one that this method of settling so important a matter will rarely if ever seeure the best methods or results. It would seem that when men are seleeted by a community to act to a certain extent as trnstees for the knowledge, morals and health of the young people intrnsted to their eare, they should endeavor to *do the very best thing* instead of the very cheapest thing. While the plans are being drawn, and before commeneing to build, is the time to deeide every point of ventilation and warming. The eost will not be one per cent more to so erect a building that when good heating apparatus is introduced there will be thorough ventilation, and *very often* we reduce the cost from the design furnished by architeet.

It should be borne in mind *that air is a substance* oeeupying space and having definite weight. An ordinary school building of twelve rooms, eaeh room eontaining, say 12,000 eubic feet of air, would contain at all times 144,000 eubie feet, but the weight of the air varies. The weight of a eubie foot of air at 70° is 0.0752 pounds and the weight of the entire body of air in the building wonld be 10,828.8 pounds. Suppose the nnmber of pnpils in eaeh room shonld require the air to be changed six times eaeh hour to secure proper ventilation, the weight of air to be moved into the house at the basement and out at the chimney tops would be 65,000 pounds

per hour. This does not take into account the cooling of the air as it passes through the building, thereby decreasing its bulk and increasing its specific gravity. Think of raising *65,000 pounds — thirty-two and one-half tons* — sixty feet in height every hour during the school day. Suppose that weight of stone is to be raised by steam; it is evident that considerable force is required to accomplish it? This shows that if a building is to be ventilated there is *work to be done*, and like any other work it will *take power* to do it.

When the fire is well managed, about 90 per cent of the heat or force thus produced is communicated to the fresh air surrounding the air warmer. Each cubic foot of air is increased in volume 0.00204 for each degree of heat added. At zero 11.66 cubic feet of air weigh one pound. Warm it to 70°, keeping the barometric pressure the same throughout, and its volume will be increased 1.66 cubic feet, making its total volume 13.32 cubic feet. The pound of air has been increased in bulk over 14 per cent. Were this 11.66 cubic feet of air inclosed in an air-tight sack which would not affect the weight of the air, but would resist the expansion, and then the air warmed to 70°, its *volume* would remain the same, while the *pressure* would be increased 14 per cent, and its specific gravity not having been changed, it would remain practically in equilibrium, without movement up or down. Now suppose the sack to be so changed as to offer no resistance to the expansion or contraction of the air. The 14 per cent of increased *pressure* would disappear, while the *volume* would be increased 14 per cent, and the sack would immediately rise like a balloon, continuing to rise, if permitted, until it reaches a point where densities are again equal where it will be in equilibrium. Thus we see that of the 100 per cent of fuel burned, if the combustion is as perfect as man's ingenuity has thus far been able to make it for practical use, ten per cent being allowed for unavoidable waste to secure good chimney draft for combustion (and that is far less than the usual waste in common furnaces), we have 90 per cent left which goes into the air as heat, an extremely active force, which is communicated to everything with which it comes in contact of lower temperature, until it gives all that it can give, when an equality of temperature is reached. When we speak of equilibrium, we use the word in a comparative sense only, and as explanatory of our meaning; for it is evident that our atmospheric air is never at rest; changes in temperature, and consequently in volume and density, following each other every moment.

Now there are two kinds of power, viz., natural and artificial or mechanical. To *lift* thirty-two and one-half tons of water, for example, requires artificial power. But natural power *drops* it. It is pumped up hill, but it runs down hill of itself. The miner digs his trench from the lake above to the mine below, and down comes the water. But the natural and resistless movement of air when warmed is *up*. With any system whatever, or with any lack of system of ventilation, air must be warmed to make a building comfortable in winter. Now, why should we use engines and fans, or other mechanical appliances to lift thirty-two and one-half tons of air *up*, when all we have to do is to make our chimney (trench) and it will *flow up*. We *lift* this great weight without any further expense than would be required to warm the room without ventilating. In our system, the only mechanical force used to accomplish ventilation is the combustion of fuel required to *warm* the rooms. We simply *provide flues of proper size, location and construction*, and the enduring laws of nature step in to bear the burden of fouled air from the rooms. This is a simple law of nature, *but its application is an art*. To determine the proper construction, location and management of the Air Warmer, the flues, the inlets and outlets, and the various details of the system is a task at which the *inexperienced will always fail*, and the *wisest will sometimes make mistakes*.

The air is continually forced to seek its level as certainly as water does, and imperfections of construction of walls, ceilings, floors and windows are thus found by this subtle fluid when the builder may claim that his work has been perfectly done, and that "the house is air-tight." Building committees therefore should not need urging by the warming and ventilating engineers to induce them not only to build of materials which are the best non-conductors of heat, but also to put in such other material as may be necessary to prevent the wind from blowing through. Common brick is one of the best non-conductors of heat that we have, but many have seen the

curious experiment of forcing so strong a blast of air against a brick wall as to blow out a lighted candle on the opposite side. Yet place a single sheet of first quality paper on the outer face of the wall, and it cannot be done. We insist, then, as a matter of economy and comfort, to secure a large saving in fuel, and greater perfection in ventilation, that extreme care must be used, as buildings are being erected to prevent cold from being forced through the walls and floors when the severe wind storms occur in our northern latitudes.

Let it be borne in mind that there is only a definite amount of heat to be obtained from a pound of fuel. All fuels have been tested, and a comparative value given in "heat units." The heat produced by the perfect combustion of one pound of coal will raise 14,500 pounds of water 1 degree, or one pound of water 14,500 degrees. The amount of heat obtainable from any fuel is therefore limited, and where combustion is equally good in two different forms of heating, the advantage will incline to the one which can properly warm the largest volume of air.

Our large and powerful Air Warmers or Furnaces, illustrations of which are given in the latter part of this book, pages 60 and 123, are perfectly adapted to the work to be done, and are an outgrowth of the demands of the "natural system" and are as much a part and parcel of the Ruttan-Smead System of warming and ventilation as a person's hat is a necessary part of his complete wardrobe. They are made on the same principle as a locomotive boiler, the best known apparatus for rapidly warming water. The natural system of ventilation requires the introduction of a very large volume of air, several times the amount used by steam and "hot air furnace" men; and the invention of our Heating Apparatus was the result of trying almost every form of heating apparatus made, with the result that we only secured heat enough with the very best to merely *move* the air in the building, thereby producing but little ventilation. But this was not enough, the air was required to be moved more rapidly and *at the same time* only warmed to a pleasant summer temperature. We have on previous pages given the origin of our Air Warmer. It will be readily seen that it is really *a part*, and an *absolute necessity for the successful application*, of the Ruttan-Smead System of Warming and Ventilating.

Cuts will be found further on of our latest patterns of furnaces. It will be noticed by those familiar with the old (see page 123), that many improvements, on which we have been granted patents, have been added. All that we need say of this powerful heater is, that it is the result of almost twenty years' effort to make *the best possible apparatus regardless of its cost.* We believe it to be the *perfection* of Warm Air Heating Apparatus, and speak for it your careful examination. *More than one hundred thousand dollars have been expended to perfect it.*

We are publishing quite a number of plans and cuts illustrating our System. We have frequently found that architects and others, not as familiar as they should be with our methods, would copy *parts* of the work shown in plans arranged or drawn by us, and yet leave the plans altogether incomplete or inadequate for thorough ventilation and warming. We will gladly give such suggestions as may be needed for the thorough and successful introduction of our system into any building if the plans are submitted to us before finally arranged. It is only reasonable to suppose that men who devote their entire time and thought to this one department of building construction should become more competent for it than a *general* engineer or architect; just as the physician who confines himself to the treatment of diseases of the eye or ear comes to know more of his particular specialty than the physician in general practice. We know several very accomplished and successful architects, who understand the theories and general practice of warming and ventilation thoroughly, and who have had great experience in arranging their buildings for it; yet these same architects, although quite uniformly successful in all departments of their work, rarely if ever complete their plans without submitting them to *professionals or specialists* for suggestions. An architect who claims to know all about every detail pertaining to the construction of a building, is unworthy of the confidence of his client.

As an illustration of this foolishness of blindly following the advice of an architect or others who have no experience, we will refer to two instances of more than one hundred of a similar nature. Six years ago we called the attention of the Board of Education of a city, which can

be named if necessary, to the fact, that as planned their building could not be either warmed or ventilated, and that to correct the error *then* they would be at no expense, and our price for the apparatus would be *eleven hundred dollars*. They thought they knew more than any one else, although no member of the board had ever had experience in building, and their architect had never built a dozen buildings of any kind. A "hot air" furnace firm sold them furnaces for *seven hundred dollars*, and we paid no more attention to the matter until a few weeks ago when we received a letter from the secretary of the board, asking an interview. Upon our arrival we found two steam fitters ready to bid on the work, and to again assure the board *that the flues were all right, and to guarantee, as did the hot air furnace man six years ago.* We found four hot air furnaces in the basement, and a stove in every school room. We again called attention to improper construction; we were awarded the contract, but, of course, had to raise our bid to cover expense to correct errors which, added to the amount paid for worthless apparatus, *causes the tax-payers to pay over three thousand dollars for what they could have secured for eleven hundred.* Possibly another instance may interest the reader, and we add an extract from a recent communication of Mr. Smead's to the Toledo Board of Education:

I have received great favors from your Honorable Board and wish to assure you that I most fully appreciate them all, but I also wish to call your attention to the fact that since the time I first presented my card to your Building Committee, who had in charge the construction of the Humboldt addition, I have asked no hearing before your Board, and have never importuned the members for a dollar's worth of work.

When I came here three years ago, your buildings were all heated either by stoves, hot air furnaces or steam. How well I do not say. I attacked your system of construction, offering my own, and after investigation by your Board, consisting of Messrs. Thurstin, Dr. Bergen, Hubbard, Zirwas, Dr. Reed, Dr. Squire, Norton, and Judge Commager, and upon the report of Mr. Oechsler, your Superintendent of Buildings, after his visit to Defiance High School building, our plans were selected and the cost of constructing the building largely reduced. This action upon our part at once raised a howl from some of the stove dealers, and especially from one or two who had been for years "blind leaders of the blind." About this time the Committee having in charge the construction of the Warren Street Building, asked me to present plans and estimates of cost of warming and construction. I attended a Board meeting *by invitation of the Committee*, and was there met by those whose revenue was being reduced by a little intelligent action upon the part of the Board, who were interested in the sanitary condition of the buildings. These parties *were ready to guarantee anything I would, claim all and more than I claimed*, and, in fact, *were ready to yell themselves hoarse to suppress the invader.* I became disgusted with their performance, and the Committee (disposed, I suppose, to be conservative,) gave the old fashioned apparatus one more chance, and with the following results:

It cost during the winter of 1883 and 1884 to *warm* and *ventilate* ten school rooms and a hall at the Humboldt building, $131.11 with the Ruttan-Smead apparatus. At the Warren building you attempt to warm and do *not* ventilate *four rooms* with the apparatus that *was guaranteed to warm eight rooms* at the time contracts were let, with an apparatus "so much superior" to ours, $334.33.

During the winter of '83–'84 it cost to warm and *ventilate* with the Ruttan-Smead apparatus at the Humboldt building, ten rooms and hall, $131.11. To warm and *not* ventilate the *same building, five rooms* and hall, it cost $305.71 with the apparatus that was said to be "vastly superior" to ours. These facts came under the observation of your Board, and a contract was made with me to improve the sanitary condition of several of your buildings during the summer of 1884, and to provide heating apparatus to warm them. *Again was the howl raised that the* Board were not consulting those who had been paid thousands and thousands of dollars to provide apparatus that *neither warms nor ventilates.* They "can do anything Smead can do." They know "more about warming and ventilating than Smead does." I will not dispute this, *but why didn't they do so before he came?* Why then did they go on year after year, introducing traps in no way suitable for the buildings in which they were introduced? On the basis of the figures taken from your books showing the cost of fuel used now, *the introduction of the Ruttan-Smead apparatus in the 99 school rooms of the city now warmed and ventilated shows that during this winter* ('84 *and* '85), *there is a net saving in fuel alone of over three thousand six hundred dollars* ($3,600). Not one cent has been expended for repairs, and I will guarantee that the entire apparatus can be put in as good condition as when set in the twelve buildings we warm for you for *fifty dollars.* Schools have been continued during the entire winter which has been the coldest within the memory of the "oldest inhabitant." Supt. Dowd said to me recently that "if the change in apparatus had not been made there would have been *weeks* during the past winter when thousands of children in Toledo would have been unable to attend school because of cold school rooms."

I only call your attention to the question of *cost.* I say nothing about the *still more important question of ventilation* for over five thousand school children, and the better attendance thereby secured, the change of air in each and every school room every fifteen minutes as shown by the meter, and ask you gentlemen of

the board, the taxpayers of Toledo and patrons of the schools and the parents of our children, who have to spend years in these buildings, have I been of any benefit to the city? What return have you for the few thousand dollars paid me? Can it be counted in dollars and cents? I know of but few who can reasonably complain, and they are the hot-air men, the plumbers, the coal dealers and the doctors. Some weeks since your Committee (under instructions from the Board, I am informed) called at my office and requested that I prepare estimates of cost of improving the condition of several more buildings, and *now the same mob are yelling again*, going around to your places of business telling all sorts of yarns, and guaranteeing *as heretofore*. They "can do anything Smead can do," "Smead has no patents to protect his system." Other cities have stolen from him, and so they recommend you to do the same; they can do better work for $1.50 or $2 than Smead can with $500! Your buildings that now *stink* can be made equal to a June morning if you will only let them send an "expert" to examine and report.

In 1882 we were requested to submit an estimate to furnish warming and ventilating apparatus for a school building in Youngstown, Ohio. We were informed that there were already in the building "hot air furnaces," and that "the only warm portion of the building during cold weather was the basement," and that was too warm; that about "100 tons of hard coal were burned annually," and schools were dismissed because of cold school rooms very often each winter; that "board were prejudiced against furnaces." Upon examination of the building we found exactly what we have seen many, many times before, namely, *small furnaces*, *small warm air pipes*, *small warm air flues*, the basement rooms *spoiled* for any other purpose than for fuel and the "hot air traps" which some inexperienced hardware dealer, or some traveling "salesman" who sold furnaces on a commission, had sold the board. They could not be used for play rooms or for janitor's quarters, and, what was *worse*, there were *no ventilating flues in the entire building;* the air of the school rooms was *simply horrible*. On page 78 we represent a basement plan of the building as we found it. A careful measurement showed *570 feet of warm air pipe*. On page 79 we represent the plan we presented for the consideration of the board. A glance at each must convince any one that the latter is the more simple.

With the *first*, the basement rooms are spoiled.

With *ours*, only a small portion is occupied by apparatus.

With the *first*, four fires must be built during fall and spring months.

With *ours*, only two fires are necessary during the fall and spring months.

With the *first*, there is a large expense for long, horizontal tin pipes.

With *ours*, there is not *a foot* of tin pipe used.

With the *first*, there was a *small*, *damp underground* cold air box, to be filled with rats, dead cats, water and rubbish that always collect around a school building.

With *ours*, a COLD AIR ROOM that can easily be kept clean.

With the *first*, there are in the building (built into the walls) small, *tin* warm air flues that are *expensive* and *difficult to introduce*.

With *ours*, large brick flues closely connected with the warm air chamber.

With the *first*, the air is conveyed a long distance horizontally.

With *ours*, the warm air only has to *rise*, which it can easily, *up* the large flues. On page 79 we represent the plan of first story, showing location of warm air, smoke and ventilating flues. Arrows represent entrance of warm air and exit of foul air. Our guarantee was, the temperature should be nearly *the same in all portions of the room;* that the variation should not exceed *two degrees*, and that *the entire building could be warmed within two hours after fires were lighted*. Notwithstanding the *simplicity of our plan*, and our *strong guarantee*, the *prejudice* of the board against furnaces was so strong that *our bid was rejected*, and steam heating apparatus was introduced. During the summer of 1883, one year later, the board, after using the steam apparatus in the building referred to, one winter, with a vacation of two weeks for repairs to apparatus, contracted with us to furnish furnaces for two school buildings, and the following letter, written by the superintendent of Youngstown schools to superintendent of Ithaca, N. Y., schools, gives evidence of the results:

Superintendent L. C. Foster, Ithaca, N. Y.: YOUNGSTOWN, O., January 29, 1884.

DEAR SIR,—Your favor received. In answer, would say that we have tried about every kind of heating apparatus, and prefer the "Ruttan-Smead System of heating and ventilating" to anything else, in

respect either to *heating, ventilating,* or *economy.* We expect to put it into two additional buildings next summer. Some of our teachers who taught last winter in a building heated with steam say that "there is no comparison." One says the change to Ruttan-Smead System has *certainly improved her health.*

Very truly, etc., R. McMillan, *Superintendent.*

We will simply add that during the summer of 1884 the Youngstown board introduced our apparatus in two more school buildings, and refer to W. N. Ashbaugh, Esq., secretary of the board, for such other information as the reader may desire.

EXPLANATION OF WOOD CUTS.

ON pages 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, we represent various drawings, showing the introduction of the Ruttan-Smead system of warming and ventilation as applied to the South Street School Building in Toledo, a large eight room school with unusually large corridor space and in an exposed portion of the city, and one of the most difficult to warm of any we have. The entire system is applied to this building, viz.: floor warming, Smead's system of continuous ventilation, and also his system of Dry Closets. This is the building referred to in the report on pages 23 and 24. We call attention to its *completeness*, and we question if there is in any city one more simple in all its parts. We of course refer to the system of warming and ventilation, *not* to the architecture. *With the latter we have nothing to do.* We do not think that one brick too many or one brick too few are used, and the same may be said about all other items that enter into its construction, so far as our work is concerned. The air warmers (furnaces) occupy spaces between walls that would be of no value for other purposes, and the dry closets (privies) are between two carrying walls, and the entire system of closets (privies) did not cost $150, while vaults could not have been built outside for less than $800 to $1,000, and then, unlike those here shown, they would have been "veritable plague spots upon the face of the earth." *The entire building, heating apparatus and all, is cared for by a woman.* No matter how cold the weather may be, a fire built at seven o'clock in the morning will secure rooms warmed to 70° Fah. at 8.30 A. M., and the air meter shows that *all the air contained in each room is changed every twelve minutes.* Does the reader ask, "Do you always obtain these results?" With rare exceptions, we do, but not always. "Why?" There are a score of reasons why. We always do the *best we can*, considering all the circumstances, but are often embarrassed by causes that should never exist, as, for instance, the interference by an architect who has friends to aid, or schemes to experiment with, or possibly by another condition that should never happen—there is not enough money appropriated to complete the building, and the item to be cut down is the very one that should be provided for at the outset, viz.: the heating apparatus, and we have been unwise enough to put in too little capacity, and as a result there come days every winter when there are one or more rooms that cannot be warmed. We are now fully determined that we never again will yield to the persuasions of a poverty-stricken, short-sighted, economical (?) board to put in capacity about which we have a question, or which must be strained to do good work. We are now fully determined to never again submit a bid on which we have the slightest doubt. If there is not enough money in the treasury to buy sufficient apparatus, the "other fellow" may secure the embarrassment that is sure to follow. *We won't.*

THE RUTTAN-SMEAD TUBULAR AIR WARMER.

THE cut on page 60 represents our latest improved furnace or "air warmer," as it appears when set ready to be inclosed in brick. On page 123 we represent the one used previous to 1885.

It will be seen that this furnace is in principle, the same as a *locomotive boiler*, only that the furnace is surrounded by *air* instead of *water*. The locomotive boiler is considered the best apparatus for warming *water* rapidly. If this is true, why should not the same principle be applied to warming *air? Heat is not a material thing.* We can only warm and ventilate our buildings by taking into them a large volume of *warm, pure air;* and therefore it is absolutely necessary that the apparatus below shall present a *large amount* of *fire surface;* and as "*fire surface*" is only surface with fire *inside* of it, this can only be obtained by retaining in the air-chamber in basement (as long as possible without impeding combustion too much) the heat generated by the burning fuel. One particle of air does not warm another particle of air; and as air can only be warmed by bringing it in *direct contact* with fire surface, we have in our apparatus covered the necessary points to secure the greatest economy in fuel and the most satisfactory results where the warming of a large volume of cold air is required. The blaze and smoke, after it leaves the fire-box, passes back through the lower flue into back chamber, then forward through the twelve long flues to front chamber, then back through the large flue to chimney. The whole furnace is surrounded with a brick case. The cold air, entering by the cold air duct, from outside, has free circulation around every part of the furnace, fire-box, flues and chambers, *and thus every square inch of heating surface is made directly available.* This furnace has more fire surface from same amount of fire, and will warm a larger volume of cold air than any other. The flues are accessible in front, *and can be cleaned in a moment*, so that it is *impossible* for them to clog up. It is warranted to burn wood or soft coal equally well. *The sides of fire-box are protected by heavy cast-iron, gas-burning linings, which can be easily removed and replaced by new ones, and at but slight expense;* and as this is done through the fuel door it is not necessary, as in other furnaces where repairs are required, to take the furnace apart. These linings stand off from side of fire-box about two inches, and prevent the burning fuel from resting against the sides of furnace over which the fresh air for the building passes, and thus red-hot surfaces are avoided. The air chamber back of the lining is supplied with air from under the grate and also through a damper directly under the fuel door. *Very hot air* is thus supplied to the fuel through the perforations of the linings, which, coming in contact with the escaping smoke, ignites it at once. The result of this is the *burning of a large proportion of the smoke and a consequent economy* in fuel of nearly *one-half* over the single fire-pots now used by others and shown on pages 58 and 59. We would call attention to the manner in which fuel is burned as compared with combustion in other furnaces. See page 63. Instead of the *deep body* of coal and the imperfect combustion in the *red-hot fire-pots of other heaters*, in this we have a thin layer of fuel (4 in. to 6 in.) spread over a *large grate* surface, with an air supply on top of fuel, consequently *much more perfect combustion, a greater amount of fire surface, and furnace heated to a much less degree.*

SMEAD'S SYSTEM OF "CONTINUOUS VENTILATION."

ON page 75 we represent a sectional drawing, representing basement and a portion of first story of South Street school building, Toledo, Ohio, cutting through plan on line BB, shown on page 67. We introduce this cut to show a very valuable feature connected with our work as now applied. By this arrangement it is *absolutely impossible for the teacher or janitor, no matter how careless they may be, to stop a flow of air through the room ;* and it at the same time *enables the teacher to secure air at any temperature desired*, that is, any temperature ranging from the external air to the warmest air that the air-warmer (furnace) can produce. If the valve is thrown back or down, all the air passing into the room is warm, and in ratio to the distance the valve is raised is the volume of the warm air diminished, and the cold air permitted to come up from below and mingle with that in the room. On page 76 we represent the register and also the valve regulator. By turning the crank to the right, cold air will come through the register, and by turning it to the left, warm air will flow into the room. The regulator is simple, neat, and easily managed.

With all kinds of apparatus, the rooms are liable at times to become too warm, owing to carelessness upon the part of janitors, and with all, except ours, if room is too warm, and the teacher closes the register, she stops the flow of fresh air into the room, which will, and without her noticing it, soon become unfit for occupancy. This difficulty is entirely done away with by the introduction of our system of construction.

We desire to call attention at this place to the register design we use for school and other large rooms ; the ordinary register has more iron than air space, while in this we have secured as little iron and as great air space as possible. The convex diamond face is screwed to an iron frame that is set when the brick walls are built, thus securing a *permanent*, *solid* and *safe* arrangement.

SMEAD'S SYSTEM OF DRY CLOSETS.

IN the book published by Mr. Ruttan can be found the following on the subject of Dry Closets:

If the city council of London, some hundreds of years ago, could have foreseen the lamentable picture presented in a late report by the Board of Commissioners to report upon the sanitary condition of the city, appointed in consequence of the effluvia arising from the filthy condition of the Thames, I cannot believe that it would ever have permitted the draining of water-closets in the sewers. This great city, with its millions of human beings, is in a most perilous and deplorable condition, and if its present system of drainage and sewerage be continued, I cannot imagine in what way it can escape depopulation by pestilence.

There should be sewers, and there should be drains, no doubt, in every large city, but only to carry off the *water*, not the sordes or the excrementitious matter from the human body; this should all be *carried* away. This idea will at first view be pronounced a most Herculean, as well as an intolerably offensive, work. Not so; *the residue of twelve ounces of excrement will weigh, when dry, only about two ounces.*

Let us suppose, then, a building (such as represented on the large inset of this book), and the water-closet to be so arranged that all deposits fall directly at base of ventilating stack. Then suppose a volume of air flowing closely over the brick or earth basin, made at the bottom to receive the sordes, and up the shaft at the rate of five feet per second all the year round, such will be the power of evaporation that one man will carry upon his back at one load the whole of the deposits for years. This surely is no great trouble or expense—nothing to be compared to the expense which is now incurred in keeping the ordinary cesspools and drains in order. In order, however, to make this residuum more conveniently available to be entirely consumed upon the premises where there is even a very small patch for a garden attached, lime, ashes or plaster-of-Paris, should be thrown down the pipes of the closet, in the proportion of about a gallon per week. This will not only render the mass hard and easily cut up for removal, but the ashes and plaster-of-Paris will *fix* and retain a great portion of the ammonia, so valuable to flowers, and, indeed plants of any kind.

But let us look at the actual state of things as at present. Every water-closet and cesspool is drained into the sewers; the mouths of these sewers are in general run down to the edge of some body of water, which does not always cover the *whole* mouth, as it should do in order to exclude the air, and especially does it not exclude the air at low water where there is a tide. The consequence is, that every house whose drain is not in perfect order becomes a foul-air shaft for the sewer, and the heat and chimneys accelerate the flow of air from the drains upward and into the building, and especially so when the wind blows into the mouth of the sewer, which it frequently does. The inmates, therefore, of these dwellings have not only to endure the malaria generated within their own dwellings, but have also the *advantage* of that of their neighbors. I have stood at the mouths of many sewers, and instead of experiencing any offensive odor as I had expected, I frequently found a strong draft *into* the sewer. Thus, in these cases, these sewers carried down the insoluble matter which, in a sanitary point of view, could do little harm, while the noxious gases were carried up into the houses.

These sewers, instead of thus becoming the greatest nuisances we have, might, in addition to being the conduits for the waste water, be turned to good account in the ventilation of a whole city. Erect foul-air shafts—say about four for every mile—at convenient places adjacent to the sewers, and connected with them by underground ducts, and the exhaustion thus brought to bear upon the sewers, and the sewers upon the drains, would go far to improve the sanitary condition of our cities. If the civic authorities would be at half the expense of the erection of the many furnace-shafts scattered over our largest and most populous places, upon condition of the proprietors allowing a connection with the sewer in the way stated, a very cheap and effectual exhaustion might be had. In general, however, a single shaft, erected at or near the mouth of a sewer, would, if properly built, be found suffieient.

For many years, whenever an opportunity presented itself, Mr. Smead introduced in residences the plans suggested by Mr. Ruttan, and always successfully; but as his suggestions could not be followed when there were a large number of persons to use the closets, as only a very limited number of seats, not more than two, could be used, and that they must be located *above the basement*, and never receiving any encouragement from his business associates, but little was done until the establishment of the office at Toledo. The circumstances attending the adoption of his ideas are fully covered in the following extract from the annual report of the President of the Toledo Board of Education:

Two years ago the Board introduced the Ruttan-Smead system of heating and ventilation into the new part of the Humbolt building. Six rooms were heated by this system and six by the old hot-air furnaces. An excellent opportunity was thus afforded of comparing the two systems as to efficiency and economy. A careful account for the entire year was kept of each side, and the result showed that the new system was what was claimed for it. It heated and thoroughly ventilated the rooms, and the schools on that side were not dismissed for a single day. A test with an air-meter showed that on ordinarily cold days the air could be changed from six to eight times per hour. As to economy, it cost $236 less to heat and ventilate these six rooms than it did to heat the other six by the ordinary hot-air furnace. So successful was the experiment, and so well pleased was the Board, that the new system was ordered placed in the six new buildings subsequently erected. The unsatisfactory condition of the heating apparatus in the old buildings and the constant complaint of parents and teachers on account of having to dismiss on cold days, led the Board to investigate the expense of introducing the new system into the old buildings. After a careful investigation the Committee on Buildings reported that an introduction of the Ruttan-Smead system into six old buildings would secure the same results as were secured in the Humboldt building, and at a saving of fuel of about $1,800 per annum. This saving in fuel alone would in seven years pay for the cost of making the change, to say nothing about the saving of valuable time of the pupils on account of no dismissal of schools from the cold condition of the rooms. The change recommended was made.

It is a matter of congratulation to the patrons of the schools that we now have ninety-eight school rooms out of a total of one hundred and fifty-eight thoroughly heated and ventilated. It is safe to say that there is no city in the United States that has its school rooms better heated and ventilated than the city of Toledo.

SOUTH STREET BUILDING.

Most of the school buildings in our city are three stories high, thereby causing a great deal of unnecessary climbing of stairs. The Board some time ago concluded that it was best hereafter to erect buildings only two stories high. The South Street building is the first complete building of this kind ordered erected. It is composed of eight rooms, four on each floor. The basement is large and roomy. In connection with this building another important departure was made. The board have long been of the opinion that it is unwise to force little children in inclement weather to pass through rain and cold to yard water-closets, and were also sensible to the unsatisfactory arrangements of closets in the buildings. In this dilemma, a consultation was invited with Mr. Isaac D. Smead, heating and ventilating engineer, who was known to have applied successfully the Ruttan and Smead systems of ventilation to the construction of water-closets located in basements in such manner as to remove all objections. Upon consultation and examination of the plans presented, it was found that it would cost much less to construct closets upon this plan than upon any other, and the work was ordered done.

At the time of the writing of this report, and after the occupancy of the building, it is found that the basement is entirely free from all malodors, and an examination of the closets will convince any one that the system must be a complete success.

If possible, changes should be made in the other buildings that will obviate the necessity of passing to closets through rain and cold.

In this connection we will add that, since the above report was written, the Toledo Board of Education have introduced the Ruttan-Smead system of warming and ventilation, and also the Isaac D. Smead system of dry closets into three more buildings—one new and two being old, three-story twelve room buildings. From the two last we removed steam-heating apparatus and old system of water-closets. As in this book, on pages 67, 68 and 69, we represent the plan of a Toledo School Building (the one referred to by President Zirwas), we will also call attention to the following article from the *Toledo Evening Bee* February 21, 1885, and some other extracts of similar character.

THE DRY CLOSET SYSTEM.

(*Toledo Evening Bee.*)

A TOLEDO MAN BECOMES A PUBLIC BENEFACTOR BY THE HAPPY APPLICATION OF A LITTLE PHILOSOPHY AND GOOD COMMON SENSE.

THE RESULTS AND HOW THEY HAVE BEEN ACCOMPLISHED.

Mr. Isaac D. Smead has perfected and patented a system known as the Ruttan-Smead System of Heating and Ventilation, on which he is fast gaining a national reputation. There is no doubt of its being the most perfect in effect and economy known to the world, and it so readily recommends itself that no argument is necessary to secure its introduction, wherever known, in all new public buildings, especially into school houses, where it has such a wonderful beneficial effect upon the health of the teachers and pupils.

It is not the intention in this article to treat upon the system which has already been so thoroughly and satisfactorily tested in Toledo, but to a comparatively recent and most valuable addition to it. Having succeeded in perfecting his ventilating system, so that school rooms may readily be supplied with air as fresh and wholesome as in the open fields, whose temperature can be easily graded and steadily preserved at any required degree, without producing any dangerous currents of air, varying but three degrees between the floor and the ceiling, thus securing warm feet—all this having been accomplished, there still remained one fearful evil which existed in connection with every crowded school building, and destroyed the health and comfort of the inmates in a marked degree. This was the privies, whose noisome odors and death-dealing gases continued to pervade the building, to a greater or less extent, in spite of the best and most costly appliances known. This evil can now be averted by a simple arrangement devised by Mr. Smead and his eminent success in this most important matter entitles him to an honored position in the front rank of the great benefactors of his age. Its value can hardly be estimated, and for that reason, although a delicate subject to treat upon in a public journal, an effort will be made to give *Bee* readers a plain idea of its arrangement and grand results.

The system has as yet been used in but one building in Toledo, that of the South Street School. After this building had nearly approached completion, the Board of Education consulted Mr. Smead (who was putting his heating and ventilating appliance in the building) regarding the evils which would arise in connection with the privies, which must be placed outside the building, as they were out of reach of the city water and sewer privileges. Under his direction, they then built the privies, both for the boys and girls, in the basement of the building, the total cost of which was included in the carpenter work, not exceeding $150. *Notwithstanding that this arrangement was an afterthought, and that he labored under many disadvantages in the construction of the building, Mr. Smead took the responsibility of counteracting all bad effects, and has done it completely.*

In order to obtain a perfect understanding of the practical workings of this system (which bids fair to create a complete revolution in the constructing of vaults for public buildings), the following gentlemen accompanied Mr. Smead to the South Street School building last Wednesday afternoon, on a tour of inspection: Franklin Hubbard, a member of the Toledo Board of Education; Frank J. Scott and A. E. Macomber, members of the Building Committee of the Manual Training School; Prof. R. H. Miller, Superintendent Manual Training School; Prof. J. W. Dowd, Superintendent Toledo Public Schools, and a *Bee* reporter.

An examination was first made of the ventilating and heating system, which has heretofore been described in the *Bee*. Fresh air from out of doors is supplied in such quantities as may be desired, which is heated by furnaces and passes through various flues into each school room. The same volume of air enters the room constantly, and the proportions of warm and cold can be regulated to a nicety by the

teacher, according to the requirements. After circulating through the room it passes out through grated openings which are placed at short intervals in the baseboards on the outer boundaries of the room. This warm air then passes under the floor, heating it sufficiently to warm the feet, and is carried to the foul-air room in the basement. From thence it is drawn, by way of arched openings in the brick wall, through the privy vaults beneath the seats to the brick foul-air chimney, whence it escapes into the open air, at the rate of 43,200 cubic feet per minute.

The philosophy of the arrangement is exceedingly simple. This current is created by the natural disposition of heated air to rise, and the draft thus produced in the stack is amply sufficient for the purpose. For use in summer, a small heater is built into the walls at the base of the stack, and when the draft is not sufficiently strong without it (as perhaps on damp, muggy days), a fire may be quickly kindled here, and the hot-air rising through the stack at once stimulates the draft to any required extent.

The privies are built upon a platform raised three feet above the floor of the basement, furnished with seats and lids, in the usual manner, and divided by wing partitions. No odor of any kind was distinguishable here. A seat was raised and the air-meter indicated a downward draft of 160 cubic feet per minute. These seats occupy two rows, back to back, with a brick partition between them, and have been in use constantly since September 10th last (with the exception of the week's holiday vacation) by 400 pupils.

The investigators desiring the fullest information, entered the foul-air room by way of a low door leading from the basement, which is always kept tightly closed and fastened. From here they crawled through the arches into the vaults beneath the seats, carrying lighted candles, which it was found difficult to keep burning owing to the heavy drafts of air. The deposits of these 400 pupils for a period of five months could all be readily stowed on an ordinary wheel-barrow. It has been demonstrated that five-sixths of the deposit in a privy escapes in the form of gases, through the stack. These deposits were examined carefully, and found to be more or less devoid of odor—those three days old being entirely odorless, dry and spongy.

After they had thus made the most thorough examination, the *Bee* representative called upon the several gentlemen (who from their deep interest and careful study of the subject, he deemed eminently capable of forming a correct judgment), for their various opinions, with the following result:

Mr. F. Hubbard, of the Toledo Board of Education: "I cannot see the least defect in it, and it seems to me to be the most perfect arrangement for the purpose that can be imagined. I only wish this dry-closet system could be introduced into every school building in the city, for it could not fail to prove exceedingly beneficial to the health of every inmate. The heating arrangement at the base of the chimney renders it as available in the summer season as in the winter, and during the warm months is when its great benefits will be the more perceptible."

Prof. J. W. Dowd, Superintendent of the Toledo Schools: "Everything can be said for Smead's dry-closet system, and absolutely nothing against it. There is no odor; no poisonous gases; and one great benefit is the fact that scholars will not be obliged to leave the school building in bad weather. And then, as a matter of economy, look at the small cost and complete simplicity of it. In the Jefferson building $1,200 has recently been expended to produce healthy and comfortable closets; they are more or less troublesome, and apt to get out of repair, and are not free from offensive odors by any means. The closets in the Washington and Sherman schools, where considerable money has been spent, are exceedingly bad in winter, and simply fearful in summer. Thousands of dollars have been expended upon the closets connected with the Central High School building, and although they were superior to any others in the city when constructed, there is a strong odor to them, which is at times very bad. Those connected with the other school buildings (with the exception of the new South Street School), are all out of doors, and all are more or less offensive. There is no doubt in my mind but that the Smead system of dry closets will soon supersede every other, for its superiority cannot be questioned. The same might be said regarding his heating and ventilating system, with which the other is connected. We now have it in 99 of our city school rooms, and the benefit to health and comfort and saving of fuel is very noticeable. But a few days since, a teacher in one of the rooms thus heated, who has a delicate constitution, told me that his health had been greatly benefited by it; probably it is the first instance on record where the air of a school-room proved beneficial to an invalid. In the Humboldt building, six rooms were heated by it, and six by other means; and here it was fairly tested. In the former the scholars were bright and animated, and in the latter, listless, with a constant air of weariness; the attendance in the former averaged two and one-half per cent better than the latter, owing mainly to the more healthy condition of the scholars. I am gratified to having the opportunity of expressing myself upon this subject, and could readily point out many more features which abundantly prove the superiority of this heating, ventilating, and dry closet system."

Prof. R. H. Miller, Superintendent of the Manual Training School: "The dry closet system far surpasses anything of the kind that I ever saw or imagined. I had heard it explained, but never appreciated its value until I saw it practically demonstrated. It does away with the need of plumbers, no water rates to pay, no

unpleasant odors; no use for sickly-smelling disinfectants. The system is most complete, and the test at the South Street School building ought to entirely satisfy and convince the most incredulous."

A. E. Macomber, Director of the Toledo Manual Training School: "I have been favorably impressed with the Ruttan & Smead heating and ventilating plan from the first time my attention was called to it, and a knowledge of its practical workings strengthens and confirms my original opinion. The practical benefits derived from the dry-closet system are very great; it is, without question, far superior to the water system, both in an economical and sanitary point of view. One cannot appreciate that entire cleanliness of the system without a personal investigation."

F. J. Scott, Manual Training School Board: "The dry closet system of disposing of excretory matter, as shown in the South Street School House in connection with the Smead-Ruttan system of heating, is the beginning of a revolution in the whole system of household and city sewerage. It is a study for anyone interested in this vital subject, and is one of the most useful inventions of our time. Every member of the City Council, the Board of Health and other public boards of the city, and the whole medical fraternity should give this system a careful examination."

A special committee was recently appointed by the Canton, Ohio, Board of Education, for the purpose of examining into the various mode of heating and ventilating school buildings, and their report, which was published in the Canton *Repository*, embodies their disinterested opinions, and may be received as valuable evidence. After first complimenting Mr. Smead's system, as seen in a Norwalk school building, where it had recently been placed, they say:

"We then went to Toledo, and reached the first building examined, a new one, about 4 P.M. The fires were then out in some furnaces, and almost out in others. Here we found Smead's Dry-Closet System in operation, in connection with the Ruttan & Smead heating and ventilating system." * * * * * [Here follows a description of the system similar to that already given.] The report of their inspection of the closets at the South Street School closes as follows: "*The members of the committee confess that these results created in their minds a deep and profound sensation. Here was a system of closets sufficient to accommodate six hundred pupils, in constant use for four months, at an original cost of not to exceed* $150 *in perfect condition, with no noisome odors; no unsightliness; no pipes; no water works; no plumbers' appliances; no sewerage system; no loathsome and disease-creating cesspools; no stifling disinfectants; nothing but a free and unobstructed circulation of God's atmosphere, which had already performed the double and important functions of heating and ventilating the rooms above, in which over four hundred children had been engaged these four months in their school work.*

It is to be hoped that the benefits of Mr. Smead's valuable improvements in heating and ventilating may be extended until it has been universally adopted wherever it is found practicable; and also applied to the ventilation of sewers as soon as possible. Thus every public building and private residence, which has sewer connections, may receive all of those benefits which we have attempted to portray. The value of such an arrangement, in preserving the health of the city, can hardly be estimated.

The introduction of Isaac D. Smead's system of heating and ventilating and dry-closets in all of our school buildings is no doubt one of the best arrangements which could be devised for the preservation of the health of pupils and teachers. This has been most satisfactorily demonstrated where it has already been in use in the city, and its value is therefore beyond all estimate in dollars and cents, Its economy in the annual saving of fuel, repairs, water rents, etc., also amounts to a large sum in the aggregate.—*Toledo Bee.*

"We have the Isaac D. Smead system of heating and ventilating and dry closets in our new school building, in the third ward, and too much cannot be said in its praise. Not one of the rooms in this large building but has been enjoyably comfortable every day this winter, no matter what the temperature was outside. The dry-closets are a perfect success, and Supt. Knott says, taking the building in all its appointments, it is the model school building of the state.—*Tiffin Daily Herald, February* 27.

We also add the following article upon the subject written by Mr. Otis Jones, President of the Ruttan Manufacturing Co., of Chicago:

Our Dry-Closet System, as patented by Isaac D. Smead, March 31, 1885, will convince the most skeptical of its superiority over any other system in use. Two others are practiced. The first and most common is the old vault plan, in which the vault is used until it is filled, when either the *building* is placed on a new vault and a little earth thrown over the old one; or, during the night, as secretly as possible, the contents of the vault is removed by night-soil scavengers, taken to the limits of the city, where a pit is dug, the excreta dumped in and a few feet of earth or sand covered over. There it lies for years, a festering mass of corruption, *a veritable plague spot upon the face of the earth.* In the course of time (how near eternity the "time" may approach no one can tell), these disease-breeding particles will be absorbed and changed by the surrounding earth; but this is mainly through the action of the atmosphere and sunlight, the more deeply it is

covered the slower the action, and the longer the danger continues. However horrible the odors may be, they are not in themselves poisons, but are notices to man, spoken in Nature's loudest voice, that the penalty for taking the poisons from whence the odors come into man's system is death.

The second plan is the Water-Closet system as used in most large cities. It consists in washing all the excreta in pipes, provided for the purpose, from the houses of the city into running streams, or large bodies of water where "in course of time" it becomes so dissipated by the action of the water and atmosphere as to cease to be injurious. There are two very great dangers that we encounter from the use of this system. Sewer gas is a terrible enemy to life, and it requires the work of the most skillful sanitary engineers to merely keep it at bay, as it is ever waiting for its opportunity, through careless workmen or imperfect material, to make its silent and persistent attack. The other danger is in the contamination of drinking water. The people of Chicago, or any other large city, need not be reminded how often there are epidemics of "bowel complaints." It is undoubtedly true that "winter cholera" and other similar epidemics have been caused entirely by sewage contamination in the drinking water. The recent terrible typhoid fever scourge at Plymouth, Pa., was at first a very mysterious disease, but the mystery disappeared when the drinking water was analyzed. It was taken from a small river, near the margin of which, some miles above, several privy vaults of a small town had stood for years. The filth so completely saturated the ground that it finally reached the river, thereby contaminating the water, causing great suffering to over *one thousand people* and *death to more than a hundred and fifty*, as estimated by Dr. Higgins, of Wilkesbarre. He detected the typhoid germ in the water, although it was *apparently pure*. There is a modification of the water-closet system which many scientific men, notably, George E. Waring, Jr., consider much better than the usual one we have named. This consists in having two sets of sewage pipes; one for rain water for roofs and streets; the other for the waste from water-closets, sinks, etc. The first named goes into the river or lake as in the former case, while the other is forced by means of pumping machinery some miles from the city and thrown upon the surface of a large tract of ground provided for the purpose, in some cases requiring thousands of acres for a single city. There it is left for the atmosphere to evaporate its moisture when it becomes inoffensive and inoccuous.

Now let it be noticed that in each case there is danger until the excreta has been acted upon by the atmosphere and the sunlight; and when that exposure has been free and ample, giving every opportunity for evaporation, all danger has passed from it and it is ready to be mingled with "mother earth." Mr. Duclaux claims to have recently proven, by experiments with fluids containing known percentages of germs, that *sunlight possesses a microbocide power fifty times more eneregtic than heat.* The following, taken from the *Sanitary News* of May 9th, 1885, is only one of thousands of similar cases throughout the United States:

The authorities of a county jail in Wisconsin are considerably perplexed by a problem of drainage for their institution. The building is located on low ground and within a few hundred feet is a so-called river, which is really nothing but a half-stagnant pond. For ten years the drainage of the institution has been directed towards this "river," through an open ditch, without reaching it. The result is that the ditch is full and its contents are spreading out over the low-lying ground. The waste is backing up under the building itself, and the prisoners, of whom there are never less than forty, are suffering greatly with sickness. The county commissioners want somebody to tell them what to do—and, of course, without cost to the county.

Since such epidemics are avoidable by avoiding the conditions which cause them, it becomes an imperative necessity to make the conditions as harmless as possible.

The old systems confined and covered all human excreta with greatest care. The Dry-Closet system follows an entirely different course. Each inmate of a building requires many thousands of cubic feet of fresh air per day to give him life and health, and in buildings provided with our ventilating and warming apparatus that quantity is abundantly large to absorb far more moisture each day than would be necessary for each individual. We claim that by its use there is absolutely no chance for the excrement to cause disease of any kind; that the necessary apparatus being as simple as the walls, floors, partitions, and doors of the building, will be as permanent as the building itself; that there will consequently be little or no expense for repairs while the building stands; that when a building is erected the added expense is very small; that by its use you have no frozen water pipes preventing the use of closets: no unsightly, ill-smelling privies; no waste pipes breathing forth diphtheria, scarlet fever, typhoid, death. We know it never fails and never can fail when put in as specified by us. School Boards and others who have examined it, without a solitary exception, say they believe it to be far superior to any other form of closet ever built.

We would like here to give building committees some suggestions that come from a wide experience. As Mr. Isaac D. Smead, has successfully warmed and ventilated a larger number of public buildings than any other sanitary engineer living in this country we invite careful attention to what he writes upon the following most important subject.

HOW TO SELECT WARMING AND VENTILATING APPARATUS.

"THERE IS A PRINCIPLE WHICH IS A BAR AGAINST ALL INFORMATION, WHICH IS PROOF AGAINST ALL ARGUMENT, AND WHICH CANNOT FAIL TO KEEP A MAN IN EVERLASTING IGNORANCE. THIS PRINCIPLE IS, CONTEMPT PRIOR TO EXAMINATION."—*Dr. Paley.*

ONE of the greatest farces enacted by any man or set of men, is that one very frequently enacted by boards of education and other committees having in charge the construction of public buildings. Yet, I do not know that they are entirely at fault, nor am I sure that I can make plain a better method than the one usually adopted. They generally know little or nothing about the subject of warming and ventilating or of the various kinds of apparatus in use; they simply know that they must buy some kind of a heater, and as they work without pay can give but little attention to the matter. They postpone the letting of the contract as long as possible, then invite bids, get themselves in position to be talked to by the "*agents*," allowing each "agent"—say thirty minutes to teach them all he knows upon the subject. (Ample time I admit for the majority to tell all they know of the matter, if we may judge of their knowledge by their works!!) But suppose there is among those who bid on the work to be done a careful, competent, conservative and experienced engineer, who has given a score of years to the learning of the business, who has had several hundred buildings under his personal supervision, and who is honest enough to acknowledge that he has made many mistakes in the past and is anxious to avoid them in the future, and who may have spent from $200 to $500 in preparing plans and estimates on the building under consideration, and who may have discovered serious errors in original construction or in the plans prepared by the architect; errors which if not corrected would, to his positive knowledge, cause a failure, no matter what apparatus might be used. Can he in thirty minutes time explain all these details and teach the committee a business it has taken him years to learn, or make clear to them a set of plans it may have taken him two weeks to design? Manifestly not. It is preposterous to suppose he could, and especially if he be met with and have to deny or explain a lot of statements that some "agent" or visionary "salesman" may have presented to the committee before his appearance. They (the "agents") may have told the committee that away down in some obscure corner of some distant state, "away back when Adam was a boy," the Ruttan System was a failure, and that the systems used by all others than themselves had "been used by the Chinese four thousand years ago." And after answering all these statements, how much time is left him of this "thirty minutes" in which to explain to the committee who cast the vote, and of whom perhaps not more than two or three know the difference between a plan of a building and a map of Europe. How much time I say has the engineer left to explain his methods as represented probably by an expensive set of drawings absolutely necessary to the proper execution of the contract? First-class work in any line always costs more than second or fourth-class, and as it is fair to suppose that the *student* knows more than he who has *never studied*, it is as fair to presume that a carefully prepared estimate is higher than one that is "guessed at."

I can assure the reader that it is often mighty up-hill work to get a majority vote for the best apparatus from the wise men who have devoted possibly three hours to the question. I was recently given an hour in which to answer the arguments (?) of four "salesmen," three of whom had never warmed a building one-third the size of the one under consideration, and to explain a

set of plans it had cost me $200 to prepare (no designs had been submitted by the others). I was also asked to make plain to these wise men why my bid, on which there was not a profit to exceed ten per cent, was over $4,000 higher than any of the others submitted and more than $6,000 more than the lowest. It *could not be done*, and I refused to attempt it, and the cheapest apparatus was voted in by the executive committee, but the vote was afterwards reconsidered and, owing to the earnest, honest efforts of a few members, faithful to the best interests of those who would be obliged to occupy the building (a state university), the contract was awarded to me. There are many "agents" running around the country selling "hot-air furnaces" and steam fixtures whose stock argument is that someone else has made a failure somewhere (and that generally a long distance off), and who know no more about the business of successful engineering than the average "quack" who hawks "patent medicine" about the country knows of surgery. No matter how the building may have been planned and constructed, "it is all right," and all the occupant requires to complete his happiness is the possession of their "Enreka" or "Florida." "Any hardware dealer or steamfitter can set it in position, and any ten year old boy can manage it, and no matter what the quantity of fuel used the result will be the same!" They will recommend, say a 50-inch furnace for a residence containing 20,000 cubic feet, and two of the same size for a church or opera house containing 200,000 cubic feet, and of course in the latter instance there can be but one result and that, failure. Now I have, and at a considerable length, stated the condition of affairs as they exist, and the reader would like some recommendation as to the course to be pursued by a committee who wish to avoid the errors referred to. I can only urge *investigation;* honest, careful investigation. The principles governing the question of warming and ventilating are easily understood, but the reader must bear in mind that the successful application of these principles *depends upon the knowledge and skill of the engineer* in charge of the work, and his knowledge and skill depends largely upon his *experience.* Concerning this, the customer must decide, and it is for this reason I have presented for consideration a large amount of evidence attesting the success of the work I have done. I do not claim that in an experience of twenty years I have made no mistakes, either in construction or estimates. I have made *many*, but never the same one *twice* to my knowledge, and have corrected all *at my own expense*, whenever possible for me to do so.

ISAAC D. SMEAD,

Warming and Ventilating Engineer.

STEAM HEATING

VS.

THE RUTTAN-SMEAD SYSTEM.

OWING to the general failure of "Hot Air Furnaces" for warming large buildings, and to the fact that enough steam pipe can be put into a building to make it *hot*, some who have observed the working of both, and who have never seen the Ruttan-Smead System of Ventilation, or the Ruttan-Smead Air Warmers, have come to the conclusion that Steam Heating is the only successful method in operation. After an experience of nearly *twenty* years, and an opportunity to test in *over fifteen hundred buildings*, we do not hesitate to state the following reasons why, for the warming and ventilation of School Buildings, Opera Houses, Churches, Jails and Private Dwellings, the Ruttan-Smead Air Warmers are better than any Steam Heating apparatus yet invented.

1. Because the *first cost of the Ruttan-Smead is from one-third to two-thirds less* than for first-class Steam Heating.

2. Expense for fuel is from *one-third to three-fifths less.*

3. Expense for *janitor* to care for the Ruttan-Smead is about one-half less than for *engineer* to care for Steam apparatus.

4. *Thorough ventilation* in a school room cannot be secured with Steam apparatus, at anything like a reasonable cost, and is not secured *at all* where direct radiation is used, and *never*, either with direct or indirect, *when temperature outside of building is* 12° *below zero.*

5. There is no possible *danger from explosion* with the Air Warmers, while with Steam there is *constant danger*, whether the pressure be "high" or "low."

6. There are *no water pipes to freeze, burst, and let water all through the building*, ruining plaster and furniture.

7. Repairs for Steam Boilers, pumps and Pipes, *will cost in ten years ten times as much as for the Ruttan*, and must always be made by a skilled steam-fitter, while any janitor who is competent to sweep a room, can replace broken or worn-out castings in the Air Warmers.

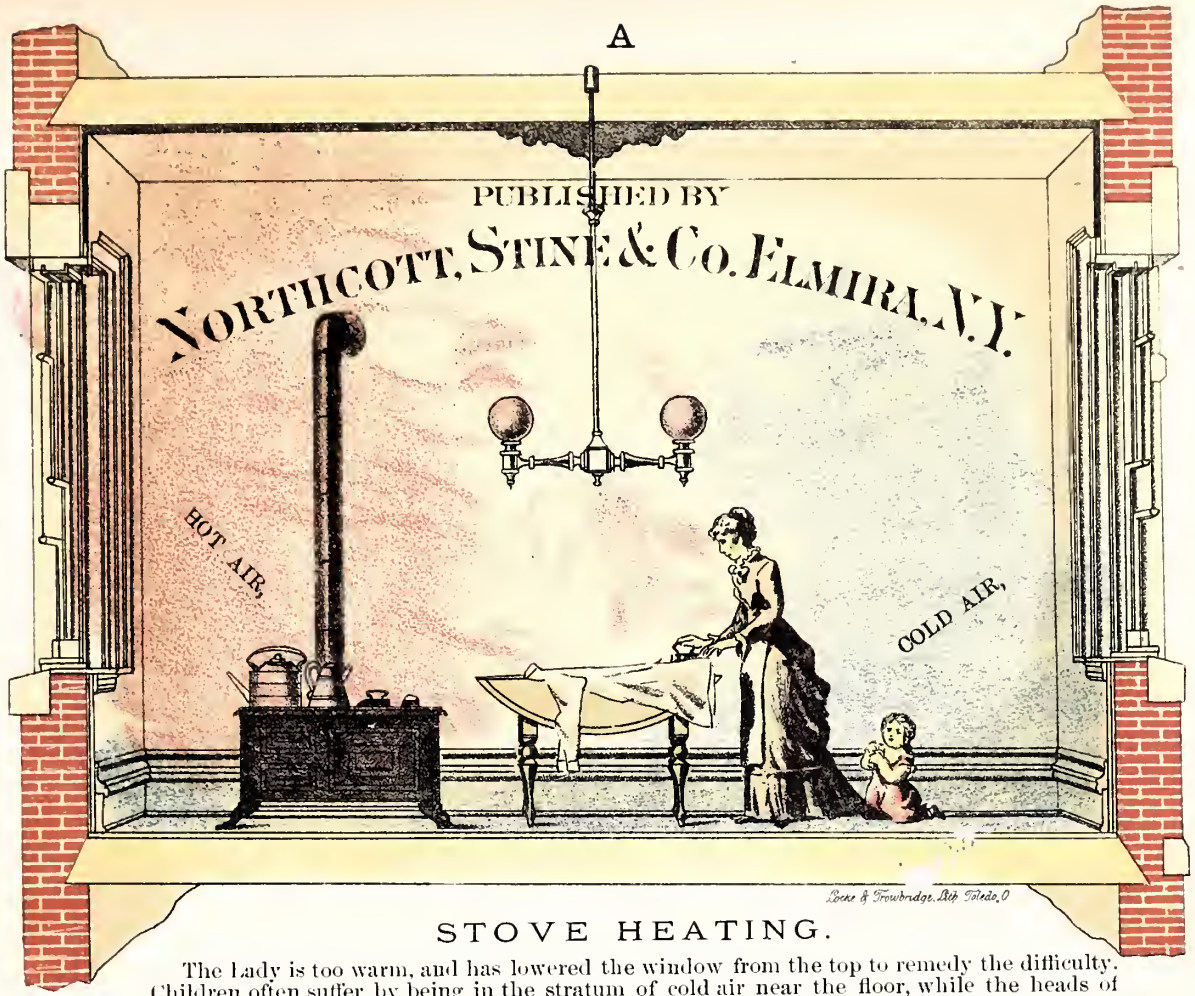
8. The Ruttan-Smead will warm and ventilate a building *during any kind of weather, no matter how hard the wind blows or how low the mercury, while Steam contractors will seldom guarantee with mercury* 12° *below zero.*

9. The Ruttan-Smead Air Warmers are set in connection with *strong and important patents, on a plan of ventilation* that no Steam contractor can use.

10. Because with the Ruttan-Smead a building *can be warmed in one hour from the time fires are fairly burning*, while from four *to six hours are required with Steam apparatus.*

11. *Three-fifths* of the force generated by the burning fuel in Steam apparatus is lost in the form of mechanical motion, and does not appear as temperature in the rooms, while with the Ruttan *seven-eighths* appears in room as temperature, and *one-eighth* only is lost.

12. With the Ruttan-Smead absolute *uniformity of temperature* can be secured throughout a building, while with Steam Heating apparatus rooms a distance from the boiler are generally *from ten to fifteen degrees colder during cold and windy weather.*



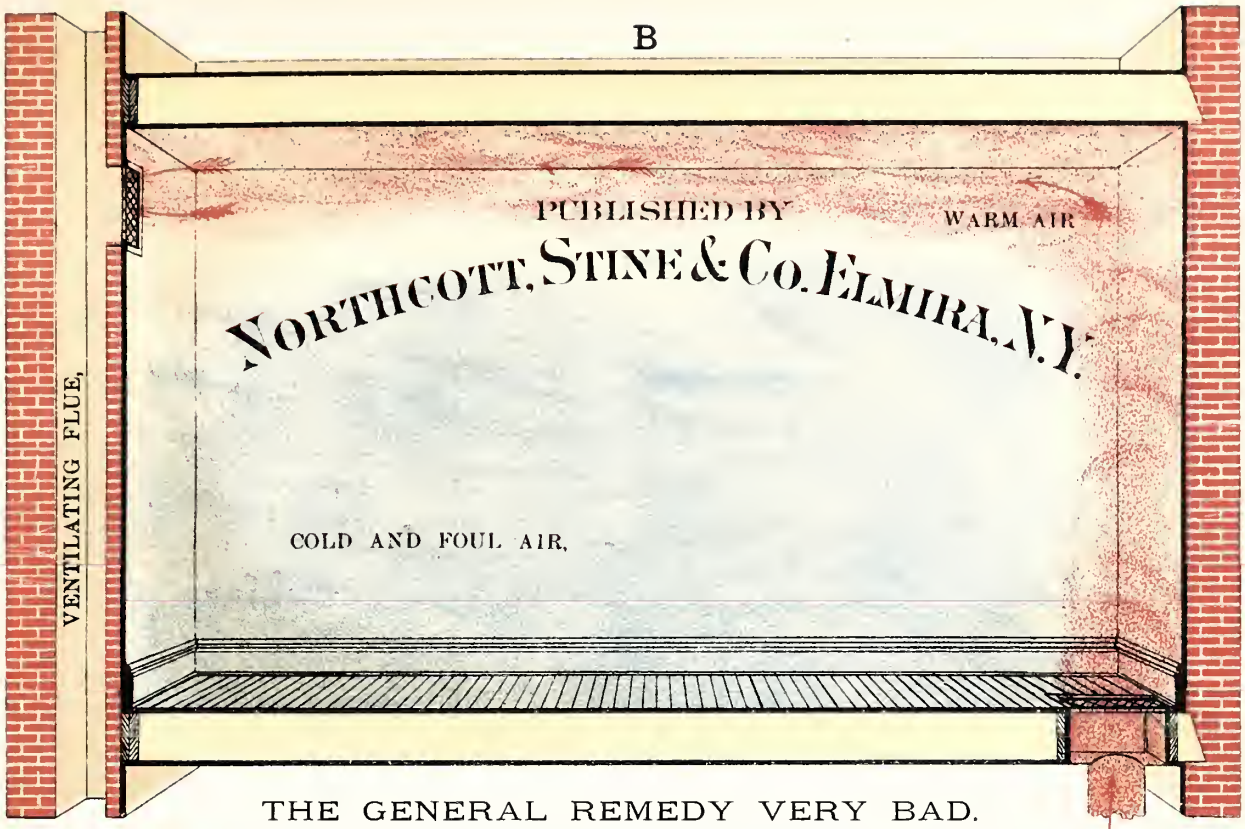
STOVE HEATING.

The Lady is too warm, and has lowered the window from the top to remedy the difficulty. Children often suffer by being in the stratum of cold air near the floor, while the heads of their mothers, or nurses, or teachers, are in a higher and hotter stratum. This is the condition of school rooms *heated by stoves or steam coils.*

EXPLANATION OF LITHOGRAPHS.

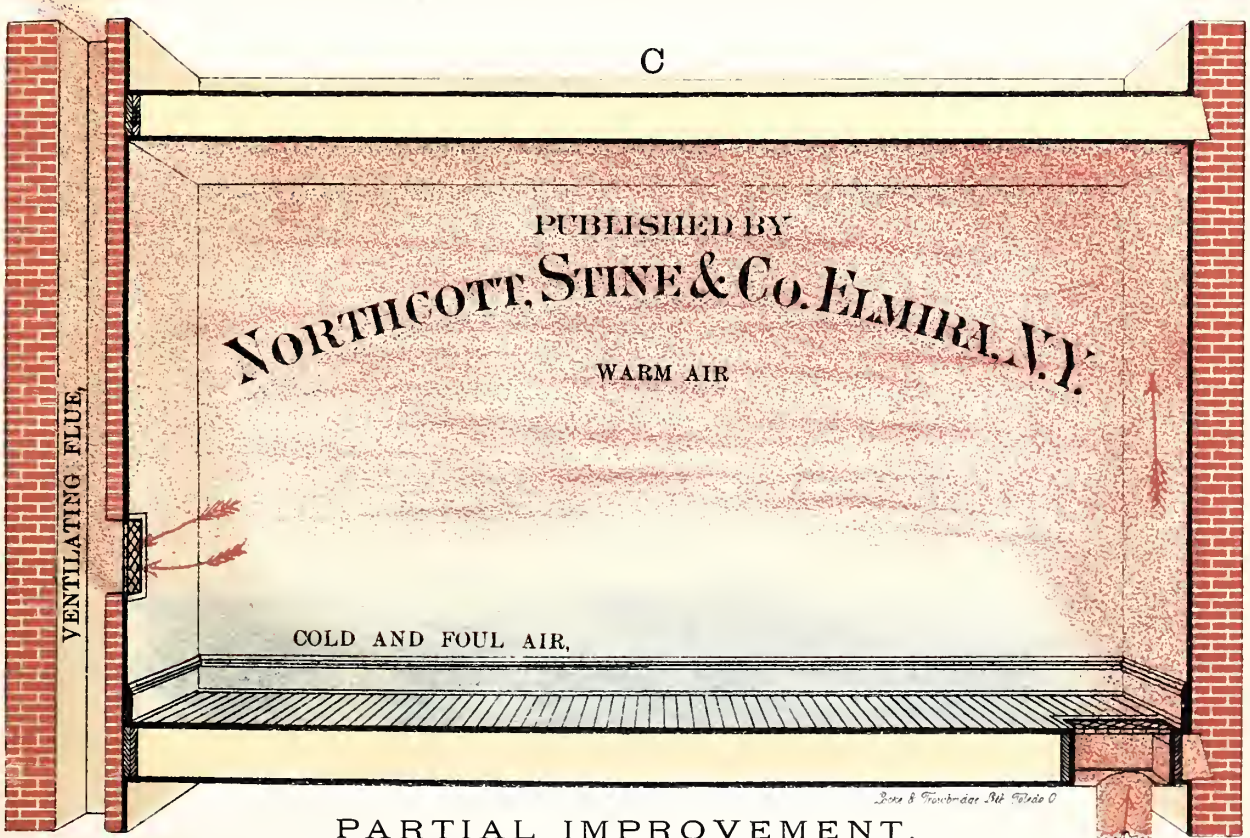
DURING the past few years much has been said and written upon the subject of heating, each manufacturer of apparatus claiming his to be the best. That the public may clearly understand the different methods, and thus be enabled to easily decide which plan to adopt, I have, at a great expense, published the cuts on pages 31, 32, 33 and 34, showing the *exact condition* of air in rooms under *all plans*, viz.: Grates, Stoves, Steam Coils, and warm air from a furnace. The red represents the warm air, and the gray the cold air. Cut "F" represents the ventilation of a room directly into a flue through a register (at base of room), or it may be done through an open grate. This is the plan we usually adopt when called upon to warm and ventilate an old building, as it is not always either convenient or possible to exhaust the air from the room under the floor, as shown in cut "G." The plan represented in cut "G" can always be successfully introduced in a building during its construction, *and the floors warmed by the heat that is lost, where the ventilation is direct.* Under no circumstances do we ever permit the use of our Heating Apparatus except in connection with one of these plans, as shown in cuts "F" and "G." It is hardly possible to exactly represent on paper a substance that cannot be seen (air) and especially to represent it in its almost constant condition—motion. The especial object of these lithographs is to represent the POSITION of air at different temperatures, as indicated by thermometer.

NOTE.—We desire to call *especial attention* to the fact that in the recommendation of the passing of warm air under floors, as shown in cut "G," we refer *only* to passing it under floor *after* its use in the room, and *do not* recommend the wild scheme of those who would pass the warm air *directly from furnace* to the space under the floor, as we *do not consider the latter plan free from danger of taking fire*, while the one we do recommend is *entirely free* from all objections, and results in a saving of fuel of about one-third over direct ventilation, as nearly all the heat contained in the exhausting air is imparted to the floor, while in direct ventilation all the heat is lost as soon as the air passes through ventilating register.



THE GENERAL REMEDY VERY BAD.

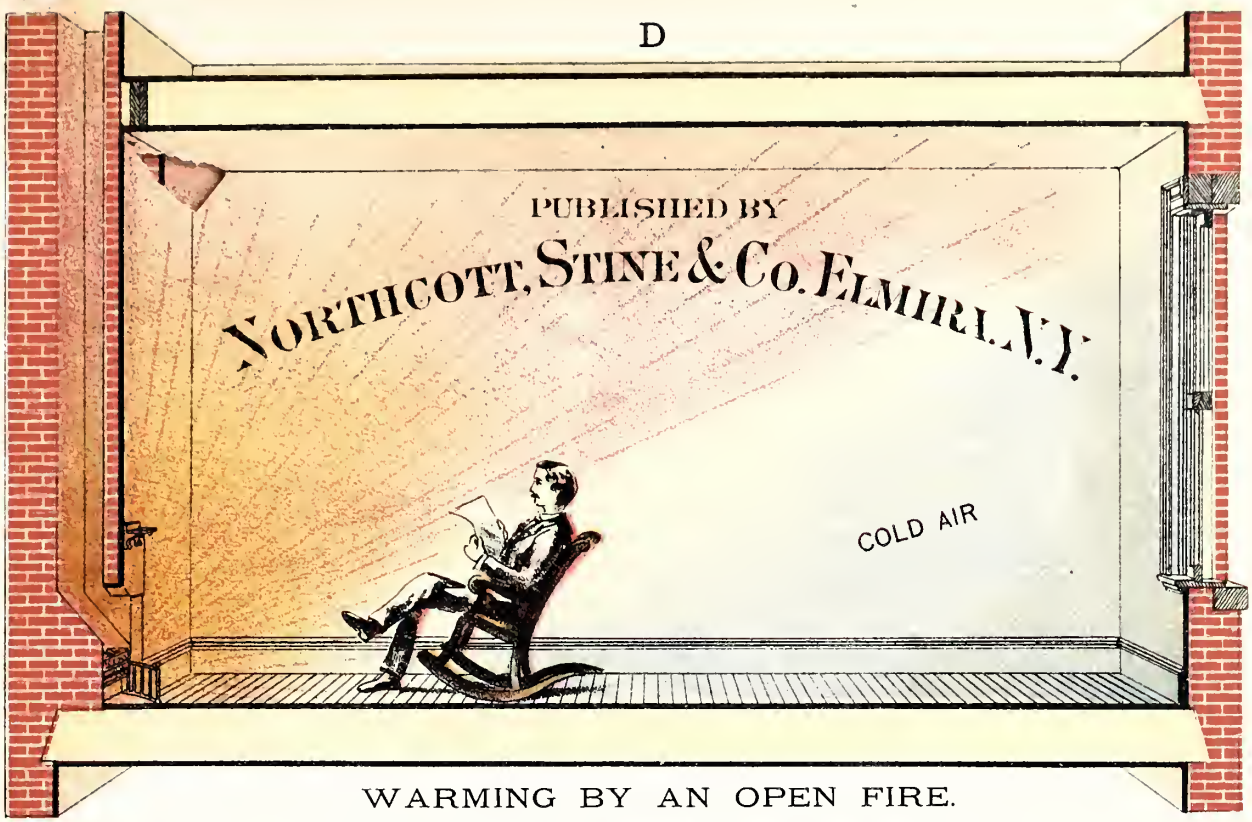
Register closed to keep warm, and no other means provided for the escape of air, the room soon becomes *pressed full* of *hot air*, producing much headache, discomfort and disease, and furnace heating condemned. THIS IS THE PRESENT CONDITION OF MOST ROOMS IN WINTER, WHERE HOT-AIR FURNACES ARE USED.



PARTIAL IMPROVEMENT.

This is better; the register is open and relieves the room of cold and bad air *down to that point*, but still leaves a stratum of cold, foul air at the floor, causing the frequent complaint of *cold feet* and *hot heads*.

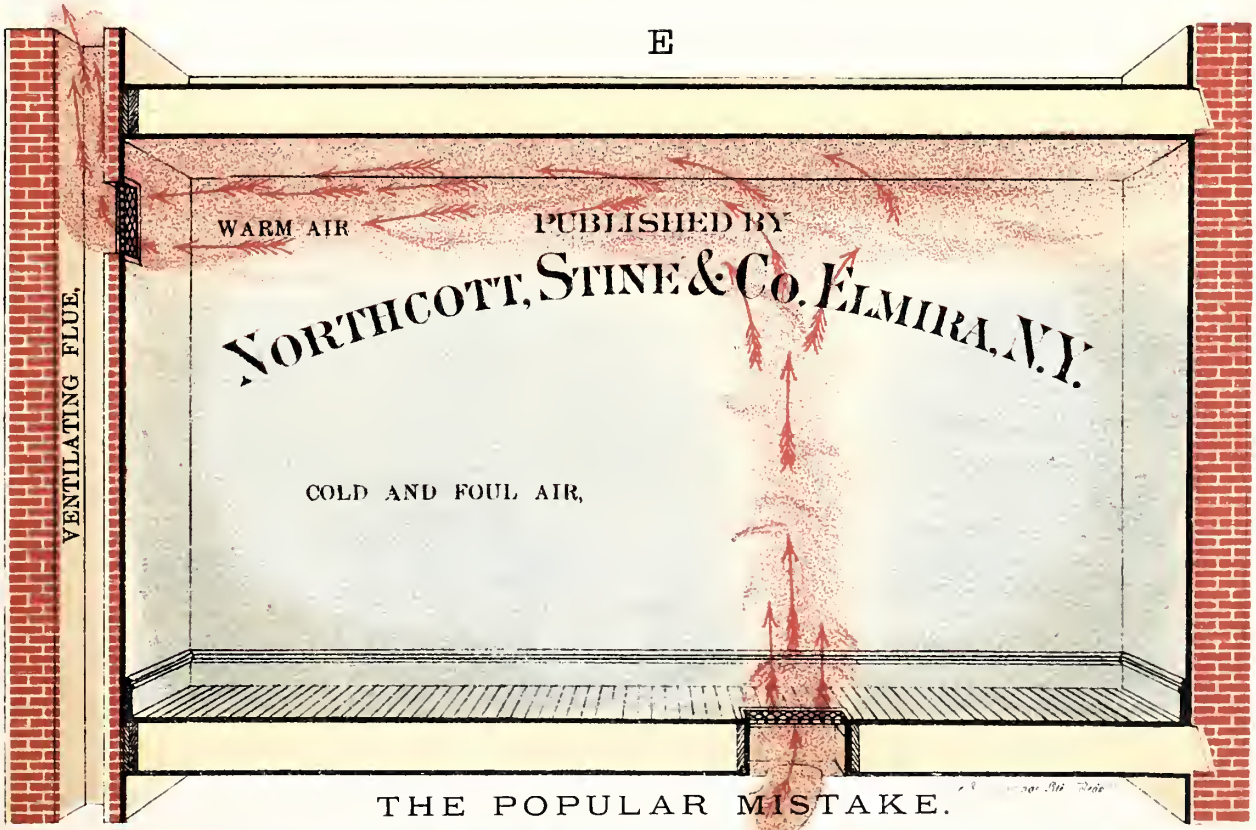
D



WARMING BY AN OPEN FIRE.

DIRECT RADIATION — (*Exclusively.*) *Feet cold and head too hot.*

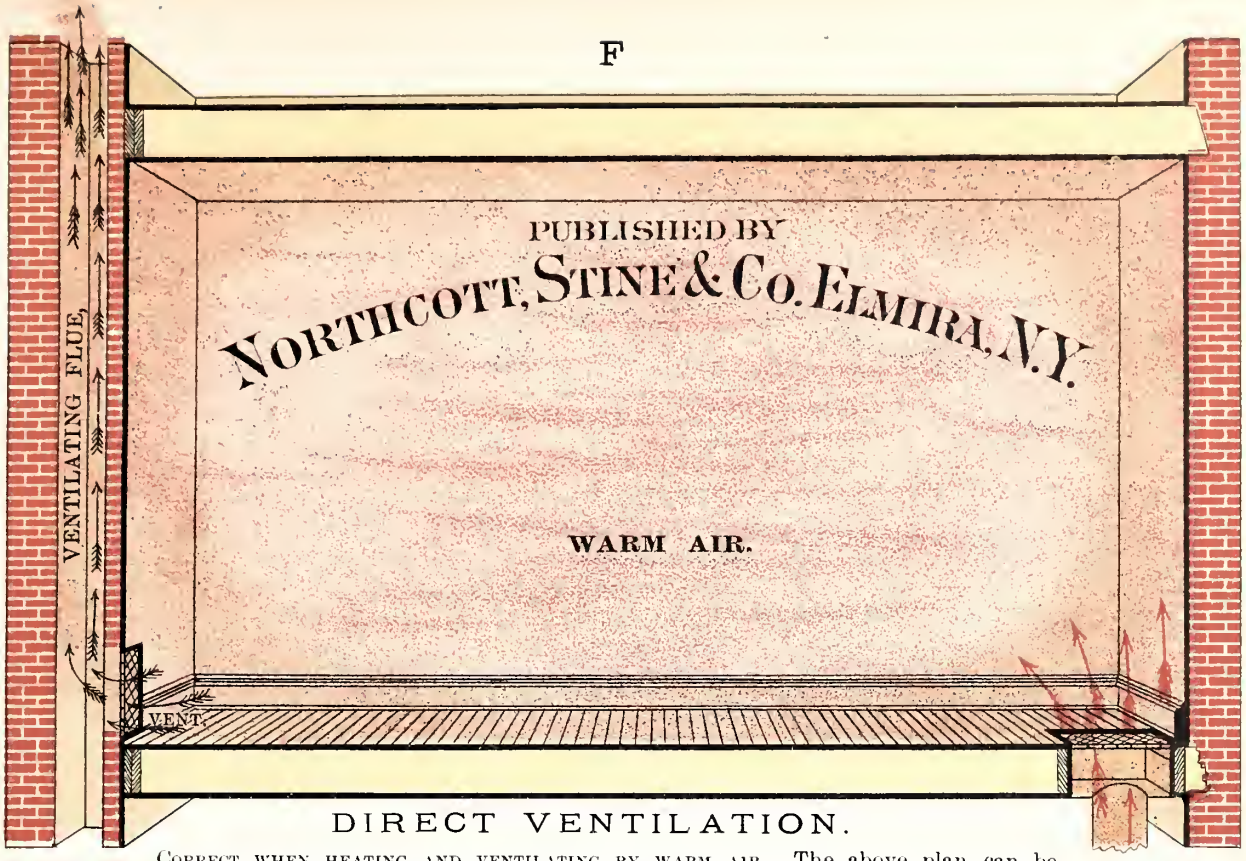
E



THE POPULAR MISTAKE.

Owing to the common mistaken belief that the breath rises, openings are generally made at the top of the room, but *as they let all the warm air out* and leave the occupied portions cold and foul, they are always closed in winter, and consequently such ventilation (?) has well earned the reputation of humbug.

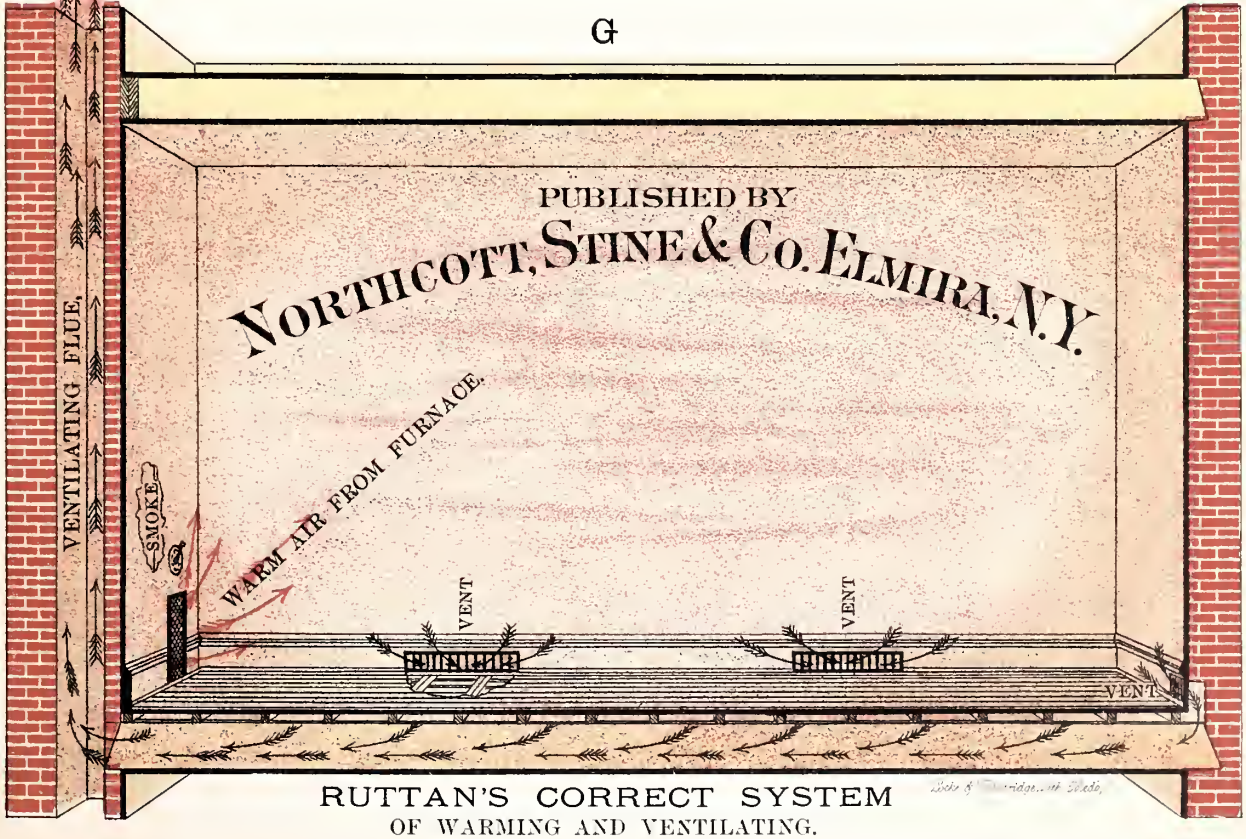
F



DIRECT VENTILATION.

CORRECT WHEN HEATING AND VENTILATING BY WARM AIR. The above plan can be built into buildings already constructed, and successfully too, provided there is some one in charge who knows how to do it.

G



RUTTAN'S CORRECT SYSTEM
OF WARMING AND VENTILATING.

By this plan the *floors are warmed*, and only one Ventilating Chimney is necessary. The above also represents Isaac D. Smead's system of "continuous ventilation" referred to on pages 21, 75 and 76.

EXTRACTS FROM THE BOOK PUBLISHED IN 1862.

BY HON. HENRY RUTTAN.

ALTHOUGH a pioneer upon ventilation upon the "exhaustion principle," I cannot of course expect entire immunity from criticism. In extenuation, however, and in justification of myself, I am bound to say that such has been the lengthened period of time which has elapsed—more than nineteen years—since I first engaged in my experiments upon the subject, and I have, in some minor points, been so closely followed up, that my first suggestions have, and may now perhaps, properly be considered *old*. I have no doubt but that some may be surprised to hear me call them *my* inventions; yet if those who question their originality as claimed by me will but think back to the year 1843, they will fail to find at that period any traces of the points in question originating anywhere except by me. However, I am not jealous or envious upon this subject; I am only too glad to find that the subject of ventilation has been progressing. I only demand that the credit upon points to which I allude shall be given where it is due.

After many years of hard work, and the expenditure of thousands of dollars, I venture to launch forth the result of my experiments in relation to the warming and ventilation of buildings.

Having read everything that I could lay my hand upon regarding the subject, and predicating my experiments upon the information thus obtained, I invariably, at the end of each experiment, found myself at fault, and just as far from accomplishing the object I had in view as ever, producing nothing more than had been obtained before me, until at last I gave it up.

Still revolving the subject in my mind I was struck with the similarity of idea running through the principle which so many learned men had adopted. So eminently is this the case, that when a person has read one of these authors, he has, so far as regards the principle of a natural process of ventilation, read them all; and this is readily accounted for by the fact that nearly all these men lived in the Old Country, where they have a comparatively mild climate, and where a system graduated to that climate was needed. Living, as I did, in a cold climate, my object was to work out a plan which would not only secure a change of air, but also insure *warmth* and an equalized temperature.

Now, here was an entirely new field, which no one had trodden before me; the warming as well as the ventilation of a building, in a cold climate, by *natural* means, and by one and the same process. So, throwing aside my books, I resumed the experiments, and soon found that no natural process of warming and ventilation could be produced unless *natural* laws were obeyed throughout; that we could not bend these to *our* wills, nor in any one jot or tittle contravene them with impunity.

Several reasons may be assigned why we have never yet, in the colder parts of America, attained to *the* system of ventilation; I say the system, because there can be but one. The fact is that our experimenters hitherto have never made any distinction in the climates of different countries, but have derived their ideas from what has been said and done in Europe, which, however applicable they may have been in those countries, are in many cases worse than useless when applied to the northern parts of this continent.

Another reason may be found in the fact that our architects, also copying from the books written in the milder countries of Europe, where little provision for either warming or ventilation was required, have never considered themselves responsible for either, and therefore have never turned their attention to the study of either.

A third reason, and one which has operated more powerfully against it than either of the preceding, is the ignorance which has hitherto prevailed as to its necessity. This, however, is now rapidly giving way before the light which has of late years been shed upon the subject; and I think a continuation of the same views will soon consummate its complete overthrow.

The chief thing now required to the general adoption of a system of warming and ventilation, by proprietors of buildings, is persons who will carry it out. For this purpose it is necessary that our architects and builders should learn how; and however presumptuous it may appear to those gentlemen for me, as a non-professional man, to attempt to teach them, nevertheless that is the object I have in view in publishing

this book. We must have men, such as we never had before—architects and builders for a cold climate. They must learn to provide the building with lungs, for unless it breathes the inmates cannot breathe. A man might as well trust to the pores of his body as channels through which to obtain the requisite supply of air, as for a builder or family to trust to cracks and crevices, or the occasional opening of a door, for purposes of ventilation.

A man may be what is called a good mechanic—he may form a piece of work after a model, and make what is called a "good job," by manual labor alone; but *he* will never become a master in his trade or calling whose powers of *mind* have no part in the performance. He must look into the reason of things; he must exercise and accustom his mind to comprehend—to grasp the whole subject, of which every stroke he strikes, or every stone or brick he lays, is but an infinitesimally small part. It is such a person, and such only, who ought ever to be permitted to meddle with the ventilation of our buildings.

Knowing the distrust with which all new ideas are received, of course I cannot expect entire immunity from those whose prejudices have, by long custom and habit, become so fixed as to be utterly ineradicable; but from the young architect and builder, and from citizens generally, I hope for a fair, honest and candid trial, and my confidence that I shall receive it, is strengthened by the multiplied indications of progress by which we are all surrounded. It is to this class, therefore, that I more especially address myself.

OUR SENSES.

It must seem to many an apprentice, brick-layer and joiner, a strange proceeding for me to attempt to convert him to a new theory, by first attacking his senses of hearing, seeing, feeling and smelling, by the statement that they are all at fault, and that none of them are to be depended upon! Yet I can assure him that such is actually the case, and that in this inquiry he will invariably be led astray if he places any confidence in them, irrespective of the philosophical examination of the laws of nature.

Of all the means, says Dr. Lardner, of estimating physical effects, the most obvious, and those upon which mankind place the strongest confidence, are the senses. The eye, the ear and the touch, are appealed to by the whole world as the unerring witness of the presence or absence, the qualities and degrees of light and color, sound and heat; but these witnesses, when submitted to the scrutiny of reason, and cross-examined, so to speak, become involved in inexplicable confusion and contradiction, and speedily stand self-convicted of palpable falsehood. Not only are our organs of sensation not the best witnesses to which we can appeal for exact information of the qualities of the objects which surround us, but they are the most fallible guides which can be selected. Not only do they fail in declaring the qualities or degrees of the physical principles to which they are by nature severally adapted, but they often inform us of the presence of a quality which is absent, and of the absence of a quality which is present.

The organs of sense were never designed by nature as instruments of scientific inquiry; and had they been so constituted they would probably have been unfit for the ordinary purposes of life. It is well observed by Locke "that an eye adapted to discover the intimate constitution of the atoms which form the hand of a clock, might be, from the very nature of its mechanism, incapable of informing its owner of the hour indicated by the same hand."

The term heat, in its ordinary acceptation, is used to express a feeling or sensation which is produced in us when we touch a hot body. We say that the heat of a body is more or less intense, according to the degree in which the feeling or sensation is produced in us. The touch by which we acquire the perception of heat, like the eye, ear and other organs, is endowed with a sensibility confined within certain limits; and even within these, we do not possess any exact power of perceiving or measuring the degree or quality by which the sense is effected. If we take two heavy bodies in the hand, we shall in many cases be able to declare that one is heavier than the other, but in what degree, or how much, our senses fail to inform us.

If we look at two objects, differently illuminated, we shall, in the same way, be in some cases able to declare which is the more splendid, but the exact difference in the illumination we shall be unable to decide. It is the same with heat. If the temperature of two bodies be very different, the touch will sometimes inform us which is the hotter; but if they be nearly equal, we shall be unable to decide which has the greater and which the less temperature.

Feeling can never inform us of the quantity of heat which a body contains, much less the relative quantities contained in two bodies. Heat, in its latent state, can never be felt at all; for example, ice-cold water and ice appear to be of the same temperature, but the difference is considerable.

If we hold the hand in water which has a temperature of about 90°, after the agitation shall have ceased we become wholly insensible of its presence, and shall be unconscious that the hand is in contact with any body whatever. We shall of course be altogether unconscious of the temperature of the water. Having held both hands in this, let us remove the one to water of a temperature of 200°, and the other to water of 32°. After holding the hands for some time in this manner, let them both be removed and again inserted in the water at 90°, and immediately we shall become sensible of warmth in the one and cold in the other. If,

therefore, the touch be in this case taken as the evidence of temperature, the same water will be judged to be hot and cold at the same time.

If, in the heat of summer, we descend into a cave, we are sensible of cold; but if in winter, we have a sensation of warmth. Now, a thermometer suspended in the cave will always show the same temperature.

Thus we see that the sensation of heat depends as much upon the state of our own bodies as upon the several agencies which excite the sensation. If we step out of a warm bath into air at the same temperature, we shall experience a sensation of coldness, because air being a more rare and attenuated substance, a less number of its particles are in contact with the body.

If we step into a room of a high temperature, say 120°, the carpet will feel cool, and the tiles of the hearth or chimney-piece will be insupportably hot. If we enter a room of low temperature, say 32°, the reverse is the case — the carpet will feel warm and the tiles and chimney-piece cold, yet the temperature is the same. If we wrap a thermometer in a blanket, and lay another upon a piece of marble, in a room of any temperature, the indications will be the same in both cases, yet to the touch the two bodies will be very different — the one will feel cold and the other warm.

The air of a room has to our sight no color, yet we know it is blue. We know that the sea is green, yet there is not the slightest indication of color in a glass full of the water. If, as we have seen, we remove our hands from water at 200°, to that which is at a temperature of 100°, it feels cold, yet we know it is warm. If therefore, the senses of seeing and feeling, and in fact all others, are so imperfect, or rather, I should say such erring guides, is it not reasonable that in all matters relating to our health we should have recourse to sources of information other than those which we know may lead us astray?

Of all the organs of sense, that whose nervous mechanism appears to be the most easily deadened by excessive action is that of smelling. The most delightful odors can only be enjoyed occasionally, and for short intervals. The scent of the rose, or the still more delicate odor of the magnolia, can be but fleeting pleasures, and are destined only for occasional enjoyment. He who lives in a garden cannot smell a rose, and the wood-cutter in the southern forests is insensible to the odor of the magnolia.

Persons who indulge in the use of artificial scents soon cease to be conscious of their presence, and can only stimulate their jaded organs by continually changing the objects of their enjoyment.

But every day's experience must convince the most careless observer how little dependence can be placed upon the sense of smell. We move into a new tenement, for instance, and we are at once sensible of a difference of smell; but in a very few days we become accustomed and perfectly insensible to it. We walk into a different apartment of the same building even, perhaps our own, and we are distinctly sensible of a peculiarity of odor, but which soon passes away if we remain in the room. We notice the loathing with which a person enters one of our prisons; in a few days, however, he ceases to complain. Pass from the pure air into an unventilated bedroom which has been occupied the night previous by a lodger, and you at once become sensible of an almost intolerable smell, yet the person who occupied it was unable to detect anything of the sort. It is just so in the case of badly ventilated houses — the inmates soon become so accustomed to the foul air they are continually breathing, that it is an almost hopeless task to convince them that it is anything but the most pure. In short, such is the uncertainty of our organs, that, delicate and refined as they may be, if our health depended solely upon their indications, they would be worse than useless to the human family.

It is indeed wisely ordered that our organs of sense should be constituted for active and practical use, rather than that they should, by the delicacy or grossness of their sensation, render us miserable; and it is especially so with the eye. It has already been observed that the eye, which was capable of discovering the atoms of which the hands of a clock are composed, would fail to inform us of the hour indicated by the same hand. It may be added that a pair of telescopic eyes, which would discover the molecules and population of a distant planet, would ill requite the spectator for the loss of that rude power of vision necessary to guide his steps through the city he inhabits, and to recognize the friends who surround him.

But, although no dependence can be placed upon the manifestations of our senses as to what may be good or evil, useful or injurious, yet the Almighty has endowed man with a mind, and a capacity to investigate, scientifically, all subjects connected with his physical existence; and this he is as much bound to do as he is to investigate those laws which are placed before us as a guide in our moral existence.

If, therefore, by ordinary observation, we cannot *see* the contaminations of the atmosphere we breathe, or detect its fetid odor, this is no more a reason why we should set at defiance all experience, both personal and scientific, than it would be for a man who would swallow a poisonous drug merely because he could perceive no difference, either in color or substance, between it and a cup of tea.

With these facts before us, establishing most clearly the fallibility of our senses, and their liability to lead us astray, it obviously becomes necessary for us to go to some other source for reliable knowledge in relation to the subject in hand. We find this knowledge furnished by science in its interpretation of natural phenomena; so let us go to that with our minds divested of all prejudice, and with a firm determination to seek only after truth.

WHAT VENTILATION IS.

Ventilation is said to be of two kinds — *natural* and *mechanical*. With the latter mode we have nothing to do, as, even were it the better way, it can never, from its expensiveness, be made available for the "million,"— which is the great object I have in view. It would be no difficult matter, however, to show that mechanical ventilation can never be made as effectual as a natural or spontaneous ventilation. It obtained in an early period, before the natural laws which govern the motions of air were inquired into; and such is the effect of the prejudice and ignorance derived from those times, that it is still extant in England, and America also, to some extent. In this mode fans, blowers, pumps, etc., are set in motion by steam or any other convenient power, and the air propelled or drawn in such direction and quantity as may be required.

The ventilation of a building is ordinarily accepted to be the removal of the foul air from within, and its replenishment by pure air from without. This is true so far as it goes, but several other points, of hardly less importance, must be taken into account also. We must not only effect a change of air, but in our climate, and particularly in the winter, the requisite temperature must be imparted to it, and it must be moved through the building in such a manner that currents of all sorts shall be avoided as far as possible.

Our dwelling stands at the bottom of an ocean of air forty miles deep. We erect brick, stone or wooden walls about us, and therefore we must find means to get so much of this ocean of air through the building as may be sufficient for our purpose. By opening windows, doors or other apertures on opposite sides of our house we can probably get a current of air *through* the building at *certain points*. Now, even if we could stand this in stormy or winter weather, and by night and day, still it would not be ventilation, because there would be only a partial removal or change of air. *Every particle and atom of air must go out*, or of course the process is not perfect. Currents of air, however, through a building, even if they would change the air (which they certainly cannot do, be the process ever so ingeniously contrived), cannot be tolerated in this cold climate, especially in winter, which is the very time when we need the most ventilation. *The whole body of air in each apartment must move together, and every local current necessary to its motion must be so guarded and concealed that no inconvenience can be felt by the inmates.*

VENTILATION OF SCHOOL ROOMS.

It is usually estimated that what with the destruction by the lungs and cutaneous transpiration and other emanations from the body, every child will contaminate, so as to render it unfit for healthy breathing, seven cubic feet per minute. A school-room, 40 by 20 feet on the ground and eighteen feet high, contains fourteen thousand four hundred cubic feet, so that in about twenty minutes one hundred pupils will contaminate this whole body. The opening of a door (or two doors, if they are both on one side or one end) of a room destitute of any open flue, will cause no *change* of the air in such room to speak of; because, if the air cannot get out it cannot come in a room; but we will allow, from this cause and from the air which comes in through the cracks and crevices, one cubic foot of air to come into such a room every minute. This fourteen hundred and forty feet every twenty-four hours will renew the air only once in ten days, so that for all practical purposes the ventilation from doors, and cracks, and crevices amounts to nothing.

If, then, the whole body of air within this school room be contaminated in twenty minutes, what state must the air be in at the end of even one day of eight hours, when it must of necessity have been subjected to the same deterioration twenty-four times! What at the end of one week (the same body of air having been carefully locked up every night for use the next day) when the emanations from the lungs and bodies of these hundred children will have been added 144 times! in four weeks, 576 times! in a twenty-weeks' winter, 11,520 times! The very walls, and especially the ceiling, of such a room become so impregnated as to affect visitors' olfactories to such an extent as to affect the stomach. This fact is within the experience of all persons who are in the habit of occasionally entering an old school house, even when no pupils are within it. Such appears to be the subtlety of this poison absorbed by the walls, ceiling and floor of a school room, that a whole summer's sweep of air through it has no perceptible effect in its extraction; the very day that it is again closed up for the winter the same smell of corruption is just as apparent as the year before.

"The condensed air of a crowded room," says one of our first chemists, "gives a deposit which, if allowed to remain a few days, forms a solid, thick and glutinous mass, having a strong odor of animal matter. If examined by a microscope, it is seen to undergo a remarkable change. First of all it is changed into a vegetable growth, and this is followed by the production of multitudes of animalcule—a decisive proof that it must contain organic matter, otherwise it could not nourish organic beings."

Dr. Hiller, Secretary of the Metropolitan Medical Association, says:

"In consequence of the ill construction and bad ventilation of the school houses in and about London, seven thousand children between the ages of five and fifteen years annually lose their lives from these causes alone."

Hear, again, another veteran in the medical profession:

"The occupation of such rooms being the lot of the larger portion of the rising generation, who can wonder that our race is degenerating in physical powers? Who can doubt that such a state of things prepares the soil and sows the seeds which in due time spring up into that luxuriant harvest of ailments and complaints which is reaped by the victims of our school rooms?

"The stupefying effects of dark, venous blood poured through the brain is unhappily most apparent where there is expected to be the highest degree of mental activity. School rooms should be provided with due means of ventilation, by which a constant supply of pure air may be maintained; the inattention, dullness and sleepiness of pupils are but the natural and inevitable consequences of taking into the system a vitiated and poisonous atmosphere. It would be wise for teachers who are afflicted with pupils of dull and stupid intellect to inquire how far the stimulus of pure air might be advantageously substituted for flogging.

"The tender, sensitive child, that sits and reads and learns his lesson, and perhaps cannot learn his lesson, and stupifies, and pines, and droops, and maybe has scarce a smile to expect when his task is done, yields day by day to his atmospheric foes. Day by day, and as he loses the first start of life, his lungs play less freely, his blood circulates more slowly, his chest contracts, his limbs pine away, his digestion is disordered, and before long he is delivered over to the tender care of the man who gallops in every other day, sends whole bales of pills and draughts, and soon settles either the life or the constitution of his unfortunate patient.

"It is needless to urge that danger to the health and life of the child is so remote and trifling as to be unworthy of consideration. The reverse is the case. Instances are constantly occurring in which the seeds of disease are gathered in the close and polluted air of the school room, to ripen into premature decay and an early death. Many parents can call to mind the frequent complaints of their children who have returned from school rooms, feverish and pale, laboring under a depression of spirits and lassitude of body. A passing emotion of compassion may have attributed their appearance to confinement and study, neither of which is productive of evil effects, unless accompanied by an atmosphere rank with impurity, habits opposed to cleanliness and health, and a loss of comfort and necessary recreation.

"In a school room with no means of ventilation, and containing from fifty to one hundred scholars, the air breathed by each different pair of lungs loses its vital properties, and becomes loaded with the impurities and infections thrown off from numerous systems. To contend that there is in this no danger to the health of the child is folly. The temporary symptoms of suffering may disappear with the habit which occasioned them, but the tendencies of disease linger in the system, awaiting some predisposing cause to develop their active strength and hurry their victim to an untimely grave.

"These statements are no exaggeration of the evil, for exaggeration is impossible. Still, the evil is allowed to exist, because its first manifestations are not in a form that appalls and terrifies. Its approach is slow and insidious; the operation proceeds in secret. At length the frame, racked with pain, a mind debilitated, unbalanced or diseased, powers of usefulness or enjoyment destroyed, are the fatal results of a few years spent in a crowded and heated school room. For all these consequences the prevention is of the simplest character. The most ordinary mechanical contrivance will insure pure air to the child and happiness to the man. That is a costly economy which sacrifices sound health and disregards the danger of disease to save a trifling expense."

WINTER VENTILATION OF A RAILWAY CAR.

An ordinary railway carriage contains something under three thousand cubic feet of air. Supposing there to be sixty passengers inside of this vehicle, and that by the lungs and the cutaneous and other transpiration each one contaminates ten cubic feet of this air every minute, it is evident that in about five minutes the whole body within the car will have been contaminated. We can form some estimate, therefore, of the intensity or concentration of this contamination when, at the end of a winter's night, of say fifteen hours, the whole body has been thus rendered filthy five times an hour—seventy-five times during the night! It is useless to point to the "ventilators" through the roof of the car, for not a particle of air can go out of *them* for the whole fifteen hours, except a little puff perhaps at the opening of a door, for I have already explained and proved that no air can leave an air-tight apartment unless that same quantity be *let into it;* and we all know from experience that none of the windows will be allowed to be opened during a winter's night.

The lungs of every adult person take in a pint of air at every breath, and this about twenty times a minute, so that into this small, tight box of a carriage there are poured twelve hundred pints of matter every minute, the reeking contents of the lungs and stomachs of these sixty passengers, some of them consumptives, and many others, mayhap, redolent of brandy and tobacco! It is quite bad enough for a person to take in, a second time, the effluvia from his own lungs and stomach, but how exceedingly disgusting is the idea of taking in the emanations, not only from the stomach and lungs but other parts of the body, of so promiscuous a crowd, for the space of fifteen hours, the matter becoming more and more putrid every minute!

Is it not a wonderful provision of nature that life can be sustained under such circumstances? and is it not beyond all comprehension that an intelligent community quietly submits to and tolerates such a state of things?

Now, couple with this the sufferings endured from cold feet, which rest all night upon an ice-cold floor, while the head is in a bath of human filth nearly up to blood-heat.

WHAT IS HEAT?

You cannot contravene the laws of nature; but if you will work with and assist her, she will cause a whole building and every apartment to inhale pure air, and exhale that which has been vitiated, just as naturally as the lungs of an animal do. Heat plays an important part in these operations, not only as a warming agent, but as a means for securing and continuing this healthy action. It is therefore proper that we should devote a little space to the consideration of its relations to ventilation.

Cold is merely a relative term; it has no existence as a positive agent or force, and is simply an absence of heat. Of heat we know nothing, except through its effects. What it really is has puzzled many a wise philosopher to satisfactorily explain; therefore we shall not presume to theorize on the subject. As stated in the preface, we only have to do with practical matters, with just so much of science involved as will aid us in our explanations. We know that heat enters into the substance of all bodies, producing greater or less results, according to its intensity. We also know that its tendency is to pass from one body to another until they all become equally heated, and the colder a body is when brought in contact with a hot one, the faster will it take up heat. For instance, take three bars of iron, one at the ordinary temperature of the air, the second just bordering on a red heat and the third white-hot. Place these together, the hottest in the middle, and the cold bar will receive far more heat from it than the one nearly red-hot. This proves that the colder a body by which you seek to extract heat from a hot one, the greater the quantity that will be obtained. Another illustration may assist in bringing out the idea more clearly. Take three pieces of sponge; let one be perfectly dry, another about half saturated and the third perfectly filled with water. Bind these together, and that which has the least water, namely, the perfectly dry one, will receive more from the one fully saturated than the partly-filled sponge will. We all have experienced the fact that we lose heat from our bodies much more rapidly in a very cold day than in one not so cold, which is accounted for by the increased difference of temperature between our bodies and the air.

This passage of heat from one body to another is called radiation, and it not only occurs in the case of solid bodies, but fluids and gases also radiate heat, though to a much less extent than solids. It is radiant heat which warms us from stoves and fire-places.

Bodies are said to conduct heat when they will take it up and transmit it from particle to particle, the whole substance becoming heated. For instance, if one end of a copper or iron rod is held in the fire, the heat will gradually creep along through the metal until the rod becomes heated the whole length. Solid bodies conduct heat much more readily than liquids, and liquids more readily than gases. Air, in fact, is the poorest conductor of heat known, being almost absolutely a non-conductor, unless it contains considerable moisture. Air, however, though it does not conduct heat—that is, transmit it from particle to particle—will carry it by its own motion. For example, if you bring cold air into direct contact with a hot cannon ball, each particle of air receives more or less heat, and, becoming lighter in proportion as it is heated, immediately rises, giving place to other particles which, receiving their share of heat, also rise, thus creating an upward current of warm air from the hot body.

Now, this is just what we want to get at. We cannot heat the air by radiation, for the heat-rays will pass directly through, without warming it a particle; and as we wish to warm the air in order to warm the apartments through which it is to pass, the only way left us is to bring the air in direct contact with some hot substance, so that it may take up heat in the manner just mentioned, and then pass in through the building we wish to warm.

This brings us to the question of fuel. What arrangement shall we construct, by means of which we can heat the proper amount of air to the desired temperature, and have as little waste of heat as possible?

It has for many years been an impression on my mind, as I have no doubt it has been upon the minds of most inquiring people, that there was a great deficiency in the generation of heat, as well as in its application to the warming of our buildings; in short, a great waste of our fuel.

We should consider that it is the air in the room that is cold, nothing else. The question, then, is: Which can I do the cheapest, warm the air where it is or get rid of it and replace it by other air that shall have been warmed?

All our aim, all our experiments, and all our practice, have hitherto been predicated upon the supposition that the body of air within the room was to be heated. Down to the year 1843, when I first began my experiments, our fire-places, our stoves, and our hot-air machinery, were all directed to this end, namely, the heating of the air already in the room. If we have but one apartment (and it is the mere heating of this that

is required), I believe that the most economical way is by the common stove; but when we have several apartments, the cheapest way of warming them is by means of other air. Indeed, there is no other way of effecting this object—the warming of several rooms from one source of heat (unless that source be placed in each apartment), than by substituting other and warmed air for that already within the room.

I once thought that several apartments might be warmed from the one in which the stove stood, and instituted many experiments predicated upon this supposition, but for all practical purposes they turned out failures. By making apertures at the top and bottom of the division wall between the stove-room and the cold room adjoining, a change of temperature would take place; but, notwithstanding the stove was made red-hot, and the room in which it stood much to warm for a person to live in, yet the adjoining room, in a zero day, could not be brought up to over forty-five degrees at the center.

This I found was entirely owing to the want of a sufficiently rapid circulation. The difference of temperature between the top and bottom of an apartment, inducing vertical movements more or less rapid according to its height, together with the direct radiation from the hot metal in the body of the immediately surrounding air, will warm a room, but it is doubtful whether the mere circulation derived from a difference of temperature merely would be sufficient to warm *it*, much less an adjoining room. Indeed, my experiments have convinced me that it is impossible to warm several apartments by one common stove, manage it how you will. If, therefore, we want to warm several apartments from one source of heat, we must induce a circulation much more rapid than can be had by means of the mere difference of temperature in the room. In a word, the air must be drawn *entirely out of the house* in order that a more rapid circulation may be had.

The removal of the air being the very process required for ventilation, it follows that it is cheaper to warm a building containing more than one apartment by the ventilating process than by any other.

VENTILATION.

BY PROF. J. A. SEWALL.

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THREE things are absolutely essential to the physical well-being of man—air, food and sleep. Deprive him of either of these and he dies. Air and food are material things to act and be acted upon in the economy. Sleep is a *condition* of the nervous system, depending upon the action of air and food. Deprive a man of air and food and he ceases to sleep; modify the air and food, and sleep is correspondingly modified. If the air be pure, the food good in quality and sufficient in quantity, other things being equal, the sleep will be sweet and refreshing; and if the air be impure, the food unwholesome or insufficient in quantity, the sleep will be imperfect, troubled and dreamy. If the food be good and sufficient, while the air is impure, the food, though good, will not act or be acted upon properly, and consequently will not nourish the body; and if the body is not properly nourished and sustained, sleep is imperfect—does not act as "tired nature's sweet restorer." Then, on the air we breathe depends all that is essential to our physical well-being or health. It is the breath of life.

Experience teaches the same fact. The lumberman of our northern pine forests, in his camp of boughs, his diet of beans and pork, lard and molasses (food that is ordinarily regarded not the most wholesome), whose habits are not altogether the best, is always strong, robust and most nearly free from all the ills that flesh is heir to. His food is coarse, his work is hard and exhausting, and he is exposed to cold, wind and storm; yet his breath in the forest by day, and in the camp by night, is the pure, life-giving air from heaven, and breathing this his food is well digested, his sleep refreshing, and bare existence is to him a pleasure.

Now, army statistics show that the field hospital is far better for sick and wounded soldiers than the best constructed and best managed post hospitals. Though in the latter every comfort and convenience seem to have been provided, yet pure air in sufficient quantity was not supplied; while in the field hospital, though much was lacking, the supply of pure air was abundant.

Again, the statistics of Europe and of the United States touching this matter, demonstrate most clearly that, other things being equal, out-door employments are the most healthy, and contribute most to longevity.

I think it needs no argument to demonstrate the proposition that man was intended by the Creator to breathe pure air.

Therefore, breathing other than pure air is a violation of God's law, and that for so doing we must and do suffer the penalty.

There is a vast amount of diseased humanity in the world, as indicated by the number of physicians, and the vast amount of nostrums offering themselves to mitigate the pain and to cure the ill. But there is no philosopher's stone, no elixir of life, no royal highroad to health. Only by regarding the conditions, observing the laws, working in God's appointed way, can we enjoy the blessings of health. And as the breath is most emphatically the life, the character of the fluid we breathe to a great extent determines the character of our physical life, whether it be good or evil.

THE PHYSIOLOGY OF RESPIRATION.

It is said that we breathe to purify the blood. But how? Why is it, then, when we wish to preserve, to keep pure, any organized matter, as vegetables or meat, we remove, as far as possible, all air, and secure it from its action? If the air will purify the blood, why not meat, or any other organized body? Now we know that the air, or the positive acting agent, the oxygen, always acts as a destroyer; its sole office is to tear down, to break up all organic compounds and resolve their elements into simple and more stable groups. Its office and tendency is everywhere the same, and unless this tendency be resisted by some antagonizing force the oxygen would speedily and completely destroy the whole organized world. Then why does not oxygen destroy the animal? It does, and yet does not. It feeds upon the very tissues of the body, and is fed by them; it demands victims to be sacrificed to appease its never-satiated appetite; and were it not for that strange and mighty force which we name and recognize, but do not comprehend — vitality — which regulates and controls the action of this agent, it would speedily resolve all organized matter into stable and lifeless forms. Literally, the organized world would be burned up and naught left but its ashes; and when vitality ceases to antagonize or resist its action we return to the dust from which we sprung.

Then, breathing is not for the purpose of purifying the blood, but to break down the tissues of the body and remove them under the direction and control of the vital principle. In all animal tissues there is a work performed which has a tendency to wear out and render unfit for service parts of themselves — parts or molecules that have lost their vitality — and these worn-out molecules become the food for oxygen. These worn-out atoms are, for the most part, hydrogen and carbon. The oxygen seizes upon them and converts them, by thus uniting with them, into carbonic acid and water, or, using another figure, the oxygen may be regarded as scavenger boats, which enter the lungs, pass into the blood, and are carried into every part of the body, where they are loaded with these worn-out elements, carbon and hydrogen. With these loads they return through the veins to the lungs and pass out into the air in the form of carbonic acid and vapor of water. They are now taken up by the leaves of the trees, unloaded, the carbon and hydrogen entering into and becoming a part of the tree, while the unloaded scavenger boats (oxygen) are returned to the atmosphere to repeat the process. Verily then, the "leaves are for the healing of the nations." This, then, is the office of respiration — *to remove the worn-out tissues of the body.*

Now if the air is more or less saturated with this carbonic acid, some of these loaded barges, when we inhale a breath of air, will enter too. The demand of the tissues is for vehicles to carry away the waste products, and the demand is imperative; and though the loaded barges go at the call of the suffering tissues, they cannot remove any of the material, for they are already completely loaded. Two atoms of oxygen can take but one of carbon, and therefore they but obstruct and block up the way, and thus produce disorder and disturbance — disease.

Now there must always be a small amount of carbonic acid in the atmosphere, because it is continually being emitted by the whole animal kingdom, and as a product of combustion and decay. Yet, by the peculiar law of gaseous diffusions, it is so completely diffused through or mingled with the atmosphere that it amounts to only $\frac{1}{2500}$ of its weight.

As the specific gravity of carbonic acid is considerably greater than that of the air, were it not for this gaseous diffusion it would settle to the bottom of the atmospheric ocean and form a layer five feet in depth.

But if only the normal amount be present, it is completely diffused, so that we find it existing in exactly the same proportion on the mountain and in the valley. But if more than $\frac{1}{2500}$ be present, the tendency is to settle at the bottom, making the ten per cent of carbonic acid greater near the surface than in the higher regions. Thus in the *Grotto del Cane*, in Italy, where the gas escapes in large quantities from the earth, all animals entering the cave almost instantly die from the effect of breathing the carbonic acid. Now, if the air contain only one or two per cent, its effect is clearly poisonous. If ten per cent, it produces immediate death.

HEAT AND VENTILATION.

We have attempted to demonstrate that pure air is the normal breath of man, but art and civilization have induced conditions which, to a greater or less extent, interfere with or antagonize the purely normal conditions.

Man finds that it is necessary to his comfort to be sheltered from the heat and rain of the tropics, and from the heat and cold and storms of the temperate and frigid regions. To accomplish this end he erects the roof and builds the walls about him; in short he builds a house.

Now this house is an evidence of high civilization; it adds to his comfort. But by living beneath this roof, within these walls he has to a certain extent disregarded the normal conditions, for the air within the confined space is not so pure as that which surrounds it, and therefore his respiration is imperfect. Again, in all the regions of the earth north of 25° south latitude, and south of 25° north latitude, man finds that artificial heat is necessary, and in our latitude is required in our houses for more than half the year. Here, then, is another artificial condition, and one which, to a greater or less extent, interferes with the natural or normal condition. If the fire be made to burn in an open fire-place, or in a close stove, a portion of the oxygen of the air is required to oxidize the fuel. Now, if the supply from without be sufficient, both for respiration and combustion, little heat could be imparted to the room, because the supply must be of the same temperature as that of the air outside the house. On the other hand, if we cut off the full supply the air in the house might be warmed, but would be rendered impure. In short, the air would be as we find it in nearly all our houses—hot, but poisonous. No doubt that either the old-fashioned fire-place or the more modern coal-grate is the best contrivance for warming. But a strong objection is, as we have stated, the drafts of cold air induced; added to this is the great expense. In fact, the latter objection is so great that these methods have been already entirely abandoned.

Few persons seem to understand just how the air in a room is warmed. It is generally thought that the air in immediate contact with the burning fuel or heated stove is warmed, and that this warms another, and so until all the air in the room is warmed. Not so at all. The air next to the burning fuel, in the case of the open fire, is warmed, and for the most part goes up the chimney. A small part, however, arises, and the cold air takes its place. The heated air that rose, slowly cools, and is displaced by the warmer and rarer air just escaped from immediate contact with the fire, and after a time falls and is again warmed. So that we see only a small part of the air of the room is warmed, while whole oceans are heated and escape from the chimney. If a stove be used for heating, only a small part of the air comes in contact with the burning fuel, —in fact, just enough to oxidize the fuel, while the air about is heated and rarified, and then pressed up by the cooler and heavier air, which is in turn heated and forced up, and thus we have a current of air established, moving toward the stove, then up to and along the ceiling, then down to be warmed again. But as this current takes place in a closed room (and the tighter the better, we think), of course it is the same air moving in a circle, to which we are constantly imparting the carbonic acid of the breath, which is warmed and circulated and breathed again, and if our rooms were absolutely air-tight, in a short time the air would be so saturated with carbonic acid as to produce death. *We shall never be able to tell how much we are indebted to green lumber and indifferent workmen.*

Another method of heating is by driving steam through coils of iron pipe. Not only does this method of warming render ventilation impossible, but it is, perhaps, the most uneconomical.

Now heat may manifest itself in two ways, viz.: as temperature and as expansion. All the force generated by the burning fuel will appear in one of these forms, or a part of both. Water at the normal pressure can be heated to only 212° Fahrenheit. Consume as much fuel as you will and the water will remain at 212° Fahrenheit; but the force generated by the consuming fuel is not lost, but is transmitted to the water in the form of expansion, and the water is converted into steam. Now if the water be confined, and this tendency to expansion resisted, the temperature can be elevated to almost any extent; but if not thus resisted the temperature will not rise above 212° Fahrenheit. *As it is necessary to force the steam through the pipes, this expansion must be resisted until sufficient force is accumulated to accomplish this result. Now this mechanical work is performed at the expense of temperature. If a building is warmed by steam, three-fifths of the force generated by the burning fuel is consumed in the form of mechanical motion.* The temperature of the steam in the boiler may be 400° or 500° Fahrenheit, but the pipes never indicate a temperature above 212° Fahrenheit. I have never found it above 190° Fahrenheit. On the other hand, air may be heated to 600° Fahrenheit, with but slight expansion, so that nearly all the force generated by the burning fuel appears as temperature, while scarcely a particle appears as mechanical motion. Here we see why Ericsson failed in his attempt to use heated air instead of steam as a motive power. Heat being applied to the air appears as temperature, but being applied to water appears as expansion, or mechanical motion.

Thus we see that in all these plans of heating there can be no adequate ventilation.

But as we accustom ourselves to an atmosphere impure and unfit for breathing, and do not feel any direct and immediate effect, we endure it, and think little or nothing of it; yet we wonder why we suffer from headaches and aches of every description, and gravely wonder at a mysterious Providence when some terrible epidemic of a zymotic character appears and numbers its victims by thousands.

It may not be necessary here to dwell upon the fact that by the repeated passage of the same air through the lungs it may, though originally pure and wholesome, be so strongly impregnated with carbonic acid, and may lose so much of its oxygen, as to be rendered utterly unfit for the continued

maintenance of the aerating process, so that the individual who continues to respire it shortly becomes asphyxiated. There are several well known cases in which the speedy death of a number of persons confined together has resulted from the neglect of the most ordinary precautions for supplying them with air. That of the "Black Hole of Calcutta," which occurred in 1756, has acquired an unenviable preëminence, owing to the very large proportion of the prisoners—123 out of 146—who died during *one night's* confinement in a room 18 feet square, only provided with two small windows; and it is remarkable that out of the twenty-three who were found alive in the morning many were subsequently cut off by putrid fever. Such catastrophes have occurred even in this country from time to time, though usually upon a smaller scale. There has happened one at no distant date, however, which rivaled it in magnitude. On the night of the 1st of December, 1848, the deck passengers on board the Irish steamer Londonderry were ordered below by the captain, on account of the stormy character of the weather, and although they were crowded into a cabin far too small for their accommodation, the hatches were closed down upon them. The consequence of this was that out of 150 individuals no fewer than 70 were suffocated before the morning.

It cannot be too strongly impressed upon the medical practitioner, however, and through him upon the public in general, that the continued respiration of an atmosphere charged in a far inferior degree with the exhalations from the lungs and skin is among the most potent of all the predisposing causes of disease, and especially of those *zymotic* diseases whose propagation seems to depend upon the presence of fermentable matter in the blood. That such is really the fact will appear from evidence to be presently referred to, and it is not difficult to find a complete and satisfactory explanation of it, for, as even the presence of a small percentage of carbonic acid in the respired air is sufficient to cause a serious diminution in the amount of carbonic acid thrown off and of oxygen absorbed, it follows that these oxidating processes, which minister to the elimination of effete matter from the system, must be imperfectly performed, and that an accumulation of substances tending to putrescence must take place in the blood. Hence there will probably be a considerable increase in the amount of such matters in the pulmonary and cutaneous exhalation, and the unrenewed air will become charged, not only with carbonic acid, but also with organic matter in a state of decomposition, and will thus favor the accumulation of both these morbific substances in the blood, instead of effecting that constant and complete removal of them which is one of the chief ends of the respiratory process to accomplish. It has been customary to consider the consequences of imperfect respiration as being exerted merely in promoting an accumulation of carbonic acid in the system, and in thus depressing the vital powers and rendering them prone to the attacks of disease. But the deficiency of oxygenation, and the consequent increase of putrescent matter in the body, must be admitted as at least a concurrent agency, and when it is borne in mind that the atmosphere in which a number of persons have been confined for some time becomes actually offensive to the smell, in consequence of the accumulation of such exhalations, and that this accumulation exerts precisely the same influence upon the spread of a zymotic disease as that which is afforded by the diffusion of a sewer atmosphere through the respired air, it scarcely admits of reasonable doubt that the pernicious effects of over-crowding are exerted yet more through its tendency to promote putrescence in the system than through the obstruction it creates to the due elimination of a carbonic acid from the blood, for it is to be remembered that while the complete oxidation of the effete matters will carry them off from the lungs in the form of carbonic acid and water, leaving urea and other highly azotized products to pass off by the kidneys, an imperfect oxidation will only convert them into those peculiarly offensive products which characterize the fæcal excretion.

Of the remarkable tendency of the respiration of an atmosphere charged with the emanation of the human body to favor the spread of zymotic diseases, a few characteristic examples will be given. All those who have had the widest opportunities of studying the conditions which pre-dispose to the invasion of cholera, are agreed that *overcrowding* is amongst the most potent of these; and from the numerous cases in which this was most evident, contained in the "Report of the General Board of Health" on the epidemic of 1848–9, the two following may be selected:

In the autumn of 1849 a sudden and violent outbreak of cholera occurred in the work-house of the town of Taunton; no case of cholera having previously existed, or subsequently presenting itself, among the inhabitants of the town in general, although diarrhœa was prevalent to a considerable extent. The building was altogether badly constructed, and the ventilation deficient; but this was especially the case with the school rooms, there being only about 68 cubic feet of air for each girl, and even less for the boys. On November 3 one of the inmates was attacked with the disease. In ten minutes from the time of the seizure the sufferer passed into a state of hopeless collapse. Within the space of 48 hours from the first attack, 42 cases and 19 deaths took place; and in the course of one week, 60 of the inmates, or nearly 22 per cent of the entire number were carried off; while almost every one of the survivors suffered more or less severely from cholera or diarrhœa. Among the fatal cases were those of 25 girls and 9 boys; and the comparative immunity of the latter, notwithstanding the yet more limited dimensions of their school rooms, affords a remarkable confirmation of the general doctrine here advanced — for we learn that, although good and obedient in other

respects, they could not be kept from breaking the windows, so that many of them probably owed their lives to the better ventilation thus established.

Now, in the jail of the same town, in which every prisoner is allowed from 819 to 935 cubic feet of air, and this is continually renewed by an efficient system of ventilation, there was not the slightest indication of the epidemic influence.

The other case to be here cited is at the Milbank Prison, in which the good effects of the diminution of previous overcrowding were extremely marked. In the month of July, 1849, when the epidemic was becoming general and severe in the Metropolis, the number of *male* prisoners was reduced, by the transfer of a large proportion of them to Shorncliff barracks, from 1,039 to 402; the number of *female* prisoners, on the other hand, not only underwent no reduction, but was augmented from 150 to 131. Now, the cholera mortality of London generally, which was 0.9 per 1,000 in June and July, *increased* to 4.5 per 1,000 in August and September; and the mortality among the *female* prisoners underwent a similar *increase*, from 8.3 to 53.4 per 1,000. But the mortality among the *male* prisoners exhibited the extraordinary diminution from 23.1 per 1,000 — which was the rate during June and July, when the prison was crowded — to 9.9 per 1,000, which was its rate during August and September, after the reduction had taken place. It is scarcely possible to imagine a more *probative* case than this; since it shows, in the first place, the marked influence of the crowded state of the prison upon the fatality of the disease; secondly, the diminution of mortality among the male prisoners, consequent upon the relief of the overcrowding — notwithstanding the quintupling of general mortality of the metropolis, during the same period; and thirdly, the yet greater increase of mortality among the female prisoners, which proved that the diminution among the males could not be attributed to any recession of the epidemic influence from the locality.

From the very full and careful statistics prepared by the surgeon-general of the armies of India, I find the mortality from cholera varied as the provision for ventilation varied. Every other circumstance and condition being the same, the mortality, where the provision for respiration was good, amounted to 15 in 1,000; where it was very bad, it amounted to 108.6 in 1,000. Not only, then, does theory teach us that imperfect respiration induces disease, but also these facts, and hundreds of others that might be cited, demonstrate the same truth. True, the effects of bad ventilation may not exhibit themselves in the form of cholera or putrid fever, but they must, and do, manifest themselves in some other way, in slower diseased processes.

With all these facts confronting us, it would seem that science might devise, and philanthropy apply some means by which, in our homes, in our churches, in our school houses, in all our public buildings, we could enjoy this necessary luxury of pure air. Various methods have been attempted for the accomplishment of this end; but these attempts have been, till within a few years ago, perfect failures, and the complaint of poor or no ventilation, almost universal. Yet the principles upon which a perfect system of ventilation is based are very simple. Two things are necessary: 1st. Pure air must be supplied in sufficient quantities. 2d. The foul or impure air must be removed. It is quite impossible to do one of these without doing the other. You cannot introduce air into a room already filled with air. You cannot remove the air from a room without admitting something to take its place.

THE RUTTAN SYSTEM.

These simple principles above referred to are those on which Hon. H. Ruttan's system of warming and ventilation is based. These are in simple conditions observed. Cold air is admitted in abundance to the "air warmer," where it is *warmed* (not heated *red-hot*, and its life-sustaining qualities vitiated), then rises, and is diffused through the room, or rooms; while the cold air, being heavier, falls to the floor, and escapes at or near the bottom of the room, passes beneath the floor, and is collected into the foul air shaft, and escapes into the outer air.

Still, it is the almost universal practice to set furnaces, and provide hot air pipes to conduct the heated air *into* a room, and make no provision whatever for the air to get *out* of the room, and in most cases no cold air duct is provided to supply air to the furnace; and yet men expect to force a current of hot air from such heaters into a room, and effectually warm it. Let anyone *think*, only for a moment, that all rooms are *always full* of air of some kind, and then remember that it is *just as impossible* to put *two quantities of air into a room at the same time, as it is two quantities of anything else;* and a man would be just as sensible, who should try to force twice as many cubic feet of marble into a room as there were cubic feet of space, as he would be who tries to force hot air into a room already full of cold air, without first providing for the cold air to go out. To illustrate: the writer, only a few days ago, was called to visit a large church, designed to seat one thousand people, which, it was said, was arranged for ventilation. And, upon examination, it was found to be arranged for heating with four furnaces, and it had some eight or ten ventilating shafts or chimneys, expected to exhaust or take the *air out* of the building, *but not one inch of opening was provided to take air in.* But the furnaces were to be set in the basement lecture-room, and then take the air from that room and heat it, and send it up into the main audience-room, and out of doors through the chimneys.

Mr. Ruttan has demonstrated by many experiments during the last twenty years, and at an expense of over $30,000, that there is no way to get the impure air out of a house except by chimneys or upright shafts. He has perfected a plan to effect this result, which is simple and cheap, and when put into the building as it is being built, costs actually little or nothing more than to build the house the ordinary way without providing for ventilation. His plan is to take the air through the "air-warmer," and then pass it from it to the rooms, through registers or transoms, and out at the bottom through an open base-board, under the floor, and thence into the chimney. By this arrangement we avoid all currents of cold air *over the floor*, as in the case with stoves, and keep the floor always warm, varying only some four or five degrees from the temperature at, say *five feet* above the floor; while in any ordinary room, warmed in the ordinary way, the thermometer will show a difference of ten to thirty degrees.

In a room thus ventilated the air cannot be impure; because, as we have before stated, the carbonic acid exhaled from the lungs, being heavier, falls to the lower part of the room and escapes, while pure air from without takes its place. Here, then, we have a perfect system of ventilation. We secure a complete supply of pure, warmed air, but without strong currents being established, while the impure air flows out continually. Another great advantage gained by this plan is the *equality of the temperature of the air. Actual experiment shows that there is not more than 5° (Fahrenheit) difference between the temperature at the ceiling and at the floor; while in a room warmed by a stove the difference is from 20° to 45° (Fahrenheit).*

This plan of passing the foul air out at or near the floor is emphatically new. It is an idea which has completely revolutionized the old systems of ventilation. The *purest and warmest air is always at the top of the room*, while the *coldest and most impure is always at the bottom.* If we make an opening at the top of the room, the purest and warmest air will escape; if at the bottom, the coldest and most impure air will escape. It would seem that it is not difficult to determine which of these two plans is the sensible or true one. It scarcely seems necessary to claim more for this system. If pure air is so absolutely essential to physical well-being, and if we can adopt any means, however expensive, to secure it, we might rest satisfied. But it is far from being expensive; while, on the contrary, a building, whether large or small, can be constructed as cheaply with such provisions for ventilation as without it, and can be warmed at much less expense than by any other plan. The cost, as compared with that of heating and ventilating by steam, is less than one-third, and as I have clearly demonstrated by a series of careful experiments and observations. As compared with ordinary hot-air furnaces, not more than one-half. As compared with ordinary stoves, it is decidedly less. In short, this system seems to possess every possible advantage. It is simpler, cheaper, and, best of all, it gives what is so much needed—a full, complete, and constant supply of pure air; and I honestly believe that when this system is generally adopted in our country, the rates of mortality will indicate a marked decrease.

HUXLEY ON THE TRUE WEIGHT OF MAN.

Professor Huxley asserts that the proper weight of man is 154 pounds; made up as follows: Muscles and their appurtenances, 68 pounds; skeleton, 24 pounds; skin, 10½ pounds; fat, 28 pounds; brain, 3 pounds; thoracic viscera, 3½ pounds; abdominal viscera, 11 pounds; blood which should drain from the body, 7 pounds. The heart of such a man should beat 75 times a minute, and he should breathe 15 times a minute. In 24 hours he would vitiate 1,750 cubic feet of pure air to the extent of 1 per cent. A man, therefore, of the weight mentioned should have 800 cubic feet of well ventilated space. He would throw off by the skin 18 ounces of water, 300 grains of solid matter and 400 grains of carbonic acid every 24 hours, and his total loss during that period would be 6 pounds of water and a little more than 2 pounds of other matter.

The following is from the *Journal of the Illinois State Medical Society.* This report was presented by A. W. Foreman, M.D., under the head of "The Houses we Live in—How shall we Ventilate Them?" He says:

"Men, in building houses, rarely pursue more than two or three lines of thought. Economy in the first cost of building, convenience in relation to the internal arrangements and external elegance, are generally amply discusssed; but the more important and subtle arrangements for ventilating, warming and lighting are scarcely more than glanced at. * * * * * * * * * * * * * * *

"We send our children to school. The houses have generally been built grudgingly by the tax-payer, who has striven to make a house containing just so many sittings as is actually necessary to accommodate the pupils of legal age in his district, taking no thought of more being necessary than four square walls, a floor under foot, and a roof over head.

"This leads me to inquire, then, what is perfect ventilation? A perfect ventilation is a constant admission of pure air into the room to supply the place of the foul air just previously exhausted from it, and the

exhaust must be perfect, removing from the room all the air it contains at any given time, at least every thirty minutes. * * * * * * * * * *

"The stove, in America, has become almost a fixed institution, especially in dwelling-houses, yet on account of its deleterious influence upon health, it should never be used. Few persons have a true conception of how air is warmed or heated, thinking, generally, that the body of air in a room lies still, and is heated by the stove imparting its heat to the air touching it, and that particle of air heating that touching it, and so on until all the air in the room is heated, just as when you put one end of an iron rod into the fire, the heat traverses from particle to particle until the whole rod becomes heated; but not so. The particles of air coming in contact with a heated body, themselves become hot, in consequence of which they lose in specific gravity, and rise—colder and heavier air rushing in and supplying their place. Thus a motion is imparted to the body of air lying within the room, and if the room be tight the air will continue to circulate indefinitely without any fresh air being admitted or any of the old air being expelled. In the meantime, the occupants have been breathing the air over and over again, and each moment adding to the carbonic acid it contains; and as the normal conditions of the atmosphere no longer obtain, an equable diffusion of its gases is impossible. The variation of temperature is so great that the feet will be cold, while the head, if not excessively hot, experiences no such want of heat as the feet do. If a door in the room be now opened, the hot air will rush out at the top, while cold air will rush in at the bottom to supply its place. The old-fashioned fire-place warms a room in the same way; but in consequence of the fact that the larger part of the warmed air escapes up the chimney, the fireplace is so expensive in fuel as not to be tolerated. Besides, as the chimney serves as an exhaust-shaft to the room, every possible crack and opening in the room sends whistling currents of cold air from every direction toward the fire, in consequence of which the side of the body nearest the fire may be as uncomfortably warm, while the other side will be as uncomfortably cold.

"The ordinary pot furnaces are equally objectionable. The quantity of air warmed is so small that, in order to furnish a sufficiency of heat to the room, the furnace, in very cold weather, is heated red-hot, and every particle of air coming in contact with it is heated to such a degree as to render it wholly unfit for respiration. The little particles of dust floating in the air will be burned to coal, and the air in the room be full of carbon. *Coils of iron pipe filled with steam are open to the same objection as the stove, besides, to warm in this way is the most expensive method in use.*

"There is, however, a warm-air furnace in use (the Ruttan Tubular Furnace) which, in connection with the method of ventilation just described, is an eminent success. It is tubular, and is an improvement upon a locomotive steam boiler, warming the air exactly as the steam boiler does the water. Its capacity is so great that the air is never heated, but only warmed to a genial summer temperature, thereby sending the air into the room in its best possible condition.

"A house thus furnished with air, brought from the outside of the house, and having no possible connection with the basement or cellar, passed through the furnace until a genial warmth is imparted to it, then passing into the room, ascending toward the ceiling, then gradually settling toward the floor, until in less than thirty minutes all the air in the room has been changed, and thus continuing from hour to hour, and from day to day, may be said to literally breathe. A house so arranged and furnished would be ventilated, because means are provided for moving the old air out of the house, and constantly supplying its place with fresh air. No other ventilation is possible, because this recognizes and acts in accordance with the specific gravities of gases which cannot be overcome. The Hon. Henry Ruttan, who, perhaps, has done more in this line of investigation than any man who has ever lived, and who has spent many years of his life and many thousand dollars of his money in trying every sort of experiment, demonstrated beyond doubt that there is no way of perfectly exhausting the air from a room except by perpendicular shafts and flues, perforated at or below the floor."

STATE BOARD OF HEALTH OF WISCONSIN.

[NOTE.—The following we copy from the report of the "State Board of Health" for the State of Wisconsin for the year 1876, by General James Bintliff.]

NECESSITY FOR VENTILATION.

HUMAN life demands fresh air, which must be in some degree pure. Eight parts of carbonic acid to ten thousand parts of atmosphere has been named as the maximum of impurity that can be endured without injurious consequences supervening. Unfortunately, in most of our public buildings (schools among the rest) the proportion commonly obtained is five times as great as that indicated by science as the ultimatum. The body has a wonderful capacity to adapt itself to surrounding circumstances. When the lungs fail to purify the blood, the liver comes to the rescue and is proportionately overworked. The fœtus supported directly from the circulating system of its mother, and having no action of the lungs to cleanse the vital current, develops a corresponding proportion of the other organ which, at the time of birth, is always largely in excess of the post-natal requirements of the system. With food of another class less prepared to sustain life, the breathing apparatus comes into operation, and the liver generally decreases in relative size. In later life the two systems of purification supplement each other on the same principle, hence minor impurities can be endured without immediate poisonous results. Children fall sick in overcrowded school rooms, and nausea relieves the stomach from food which the want of sufficient oxygen and the presence of animal impurities in the air, combined with carbonic acid, has rendered noxious to life. Such incidents are too common to procure from the average observer such attention as they deserve.

It is not too strong an expression when we assert that millions of human lives have been and are being sacrificed for want of care as to this primal necessity of our being—ventilation.

The President of our State Medical Association, Dr. J. B. Whiting, in the last annual address to that society, says with much force: Our children are crowded into school rooms that have *little or no ventilation*, except as the heat of summer admits of opening doors and windows. From fifty to seventy children are often kept in the school room by the hour when the supply of fresh air is not sufficient for one-fourth that number. If any one doubts this, let him visit the primary departments of the schools in this state at a season of the year when artificial heat is required, when doors and windows are closed, and he will find the atmosphere of the room not simply impure and oppressive, but offensive and disgusting to the sense, and his first impulse will be to escape. If he remains, the offended sense soon ceases to protest, and the visitor breathes the contanimated air with seeming impunity; but the little ones, who are compelled to live in such an atmosphere day after day and month after month, do not thus escape. The more robust live through it, but the delicate ones succumb to the poison and fall out of the ranks. * * * * * * *

Proper ventilation is impossible unless our buildings are so constructed as to permit of the best processes being carried out in their integrity. Many of the finest buildings in this country, considered merely as architectural beauties, are uninhabitable during winter in consequence of defective arrangements for heating and airing the several apartments.

The Ruttan system aims at making the house breathe; that is the design of the best process yet submitted; and if it is not invariably successful it is not for want of a correct appreciation of the great purpose which an architect should keep in view. The ventilating shaft constructed in the center of the building is traversed by the smoke-pipe, which serves for the whole structure, and this, by its warmth, compels a current of air such as will not fail at all seasons to carry off the atmospheric impurities collected from all parts of the building. The furnace is admirable in construction, and when applied to private dwellings the warm-air pipes convey to registers in every room a supply of heated pure air from without. In school and other public buildings there is connected with the furnace a continuous warm-air flue which can be tapped by the teacher to supply any lack of atmospheric freshness. After the heated air has passed through the building, traversing under the floor, specially raised for the purpose—through the partitions and over the ceiling, so that all the advantages of the Leeds scheme have been attained; the foul air, having no outlet but by the shaft already

described, *must* return to the basement of the building, radiating in its travel the last degree of its available caloric before passing through the tall chimney into the upper region of the atmosphere. Objectors to the system as now operating contend that, when the contrary winds prevail, the foul air is liable to be forced back into the building with results disastrous to comfort, and that the draught does not operate on all the rooms alike. It is even said that some rooms in well constructed buildings have altogether failed to procure ventilation under certain conditions. It has been suggested in reply, that the inconveniences deprecated as likely to result from contrary winds may be minimized or removed entirely by increasing the height of the conducting shaft and the temperature therein. The answer seems to be conclusive. The second objection, that some rooms are not ventilated at all, or partake in the general advantage insufficiently, may be found on further experience to require graduated escape-pipes, traversing the common flue, adapted to carry the foul air from each story; but a matter of detail so small as that need not be discussed in this article, *as the company concerned in introducing the system, confessedly the most successful*, will not fail to adopt every substantial improvement.

Ample experiments have demonstrated that pure air may be introduced into a room either at the top or bottom as may be most convenient; but the foul air should *always* be removed through the floor or on a level with it, and conducted to some central reservoir at the base of the ventilating shaft.

Ventilation during the summer can be secured by the same system of house-breathing, by causing a fire to be ignited at the base of the foul-air shaft. The current of air thus caused will afford thorough ventilation with cool air, without the necessity to open one window in the edifice. The advantages accruing from the exclusion of hot air, dust and insects need not be enforced. We would have the main expense incurred in the preparation of school buildings, not to adornment, much as we admire beauty and value its æsthetic worth, but to the procurement of efficient ventilation at all seasons, and healthful warmth in winter.

The ventilation of churches should receive ten-fold more attention than has been given, but the school should command the first and largest meed of vigilance, because therein those who are helpless require our protecting care, and upon the fulfillment of our obligations to them will largely depend not only their happiness and health, but the future prosperity of the nation. The boys and girls of today may be the fathers and mothers of many who will witness the next Centennial celebration, and the highest product that we can offer for the approbation of the world is a better citizenship than that which ushered in the display in Fairmount Park. We must be able to show that our free institutions and numberless advantages have attained for us commercial, inventive and manufacturing preëminence, because of the nobler manhood builded on this continent, in token of our thankfulness to Almighty God for the manifold blessings wherewith He has surrounded this nation.

REPORT OF COMMITTEE OF BOARD OF EDUCATION, BOWLING GREEN, OHIO.

To the Board of Education, Bowling Green, Ohio:

Gentlemen,—Your committee appointed to examine the different systems of heating and ventilating public buildings, and to submit to you a statement of the result of its investigations, beg leave to report:

That by correspondence and by personal examination, we became somewhat familiar with the different systems of heating and ventilation now in use in various public buildings, at Ann Arbor, Mich.; Elkhart, Ind.; Fostoria, O.; Toledo, O., and at some ten or twelve other points. Our examination of the system of heating by hot-air furnaces brought to our knowledge no improvements of such importance, in the ——— hot-air furnace, or in the ——— hot-air furnace, as would justify a substitution of either, for the hot-air furnace of the ——— make, that we now have in use. Our examination also developed that the method of heating by steam, by direct and indirect radiation, produces better results, than those that are accomplished by means of steam, by direct radiation alone. We desire, therefore, to call your attention to two methods only of heating and ventilating public buildings—specially those which are used for school purposes.

I. The method of heating by steam, by direct and indirect radiation.

Direct radiation is secured by piping, fastened to the wall, either under the windows or under the blackboard. Indirect radiation is secured either by clusters of cast-iron radiators, located in the basement at the mouth of hot-air shafts leading to the different school rooms, or by coils of pipe located in the outside walls. Air passing over these clusters or coils becomes heated, and is then admitted to the rooms through registers. We find that steam heated the buildings in which it was used, quite satisfactorily the most of the time. When, however, the wind was high, the rooms on the side from which the wind was blowing, were frequently cold. Occasionally at Elkhart, and frequently at Toledo, the schools in such rooms were dismissed because the temperature was too low for comfort. We were told that two or three rooms, were inadequately heated, even in moderately cold weather. But, as a whole, when radiators of sufficient capacity are put in, the rooms are *heated.*

The *ventilation, in the buildings heated by steam, was defective.* At Elkhart the system of ventilation was found to consist of four large ventilating shafts, running from the basement to and above the roof of the building, four air vents opened into these shafts from the different rooms and halls. To increase the exhaust currents, and thus to draw the foul air from the rooms more rapidly, heated coils were placed in the ventilating shafts. By this means some of the rooms were fairly ventilated. In other rooms, in the same building, the air was heavy. The air in one room was said to be as impure as it would be in a room heated by a stove. As far as we could learn, in none of the buildings heated by steam could the air be kept in its normal condition, and in none of them could the air be changed very rapidly.

We found that the annual expense for fuel necessary to heat by steam was heavy and in some cases *enormous.* We herewith submit a statement of the cost of heating different buildings, to which we invite your careful attention. It is estimated that to heat our school building satisfactorily by steam will cost from $350 (lowest estimate) to $450 (highest estimate) per annum. These estimates were furnished by men thoroughly conversant with the subject of steam heating. It appears, also, that to keep steam apparatus in repair necessitates a steady outlay; this outlay frequently commencing when the apparatus has been in only one or two years. This item of expense should fairly be charged to the cost of maintaining the system.

The following are objections to the successful use of steam:

(1) The temperature of a room near the floor and near the ceiling is very unequal.

(2) *The whole system has to be run in order to heat a single room,* whenever it may be desirable or necessary to use such room—a superintendent's office for instance.

(3) *At every point where we found steam in use, the ventilation was imperfect.* The replies, also, to the inquiries sent out by us are uniform on this point. Some of them put it strongly: that it is doubtful if good ventilation can be secured where steam is used.

(4) Water will run out on the floors of the different rooms whenever steam is not made slowly on first firing the engine, occasioning delay, annoyance and damage.

(5) Pipes are liable to burst in cold weather unless the boilers are emptied every night. To fill these boilers daily, in places where there is no system of water works in operation, materially increases the janitor's labor. The running of an engine all night, to prevent this bursting, increases the annu al expense.

(6) The pounding of the steam in the pipes causes serious inconvenience.

II. The method of heating by the Ruttan-Smead System of Warming and Ventilating.

The heat is produced by passing fresh air over a large warming surface. A tubular furnace is used. The air, moderately heated, passes through shafts to the various rooms. That this warm air can sufficiently heat the rooms into which it is thrown, is abundantly shown by the results already obtained in the various buildings in Toledo (the only point where we saw the system in operation).* The record shows that, in buildings in which one-half of the school rooms were heated by hot-air furnaces, and the remaining half were heated by the Ruttan-Smead System, no rooms were dismissed on account of cold in that part of any of the buildings heated by the Ruttan-Smead System, while in the other part of the same buildings, rooms were frequently dismissed on account of the low temperature. We submit herewith a copy of a letter written by Superintendent J. W. Dowd, of the Toledo schools, to J. C. Jones, of the East Saginaw schools, showing the result of the experiment in one building. The statements contained in it were also given to your committee by Mr. Dowd, when the committee called upon him for information as to the methods of heating the school rooms under his control. *The direction of the wind does not affect the ease and certainty with which school rooms can be heated by this system,* this being in marked contrast with the experience of those who have used steam. The temperature also is even in all parts of the room, as the experiment made proved.

In the matter of ventilation, this system excels all others. Foul air vents are placed at intervals around the room, near the floor, and connected with foul air ventilating stacks. By means of these openings a constant current of air is kept moving through the room. The foul air is drawn out as rapidly as the fresh air is admitted. The whole volume of air in a room can be changed in from five to fifteen minutes. A valve in the warm air flue is so arranged that the teacher can admit either warm air or cold air, or both; but in no case can she shut off the current of air passing into a room.

Tests made in different rooms and in various buildings show that the air is nearly in its normal condition, even at the close of a day's session of school. The amount of carbonic acid gas being but slightly increased, and the amount of oxygen being practically twenty-three parts. We were unable to find, either by letter or by personal inquiry, that this system of ventilation had ever failed to do all that is claimed for it.

Your Committee were surprised to find that the annual cost for fuel was so small. One building in Toledo, heated by four furnaces during the school year, 1884–85, consumed only seventy-six tons of soft coal. The Jefferson street building, during the same year, used even less than that. We also refer the board to the letter from Superintendent Dowd to Superintendent Jones, above mentioned, for the result of another experiment, in which it appears that in one year $236 *more* was required to pay for the fuel necessary to heat one-half of a twelve-room building, by a ——— warm-air furnace, than was necessary to heat the other half by the Ruttan-Smead System.

The following reasons explain how this saving in the cost of fuel is obtained.

(1) Fires are started in the furnaces from two to three hours later than can be done when heating by steam or by other methods, and yet the temperature of the rooms will be 70° Fahrenheit at the time of opening school each morning.

(2) Fires are shut off each day at 4 P.M. in cold weather, and at 3 P.M. or earlier in moderate weather.

(3) The large foul air stacks remove the impure cold air from the rooms rapidly; this allows the incoming warm air to settle to the floor more quickly, and to raise the temperature of the rooms uniformly.

(4) No fires are needed on Saturday or on Sunday, in cold weather, in order that the school rooms may be thoroughly warmed on Monday mornings.

(5) The improved perforated grate in the bottom of the firebox admits currents of air to the burning wood or coal along its entire length, prevents the accumulation of ashes or slag, and keeps the temperature in the firebox more uniform, without unnecessary waste of fuel.

The Ruttan-Smead Company, moreover, guarantee that our building can be heated with sixty tons of soft coal or sixty cords of good wood per annum, a guarantee which will protect us, and be safe for the company, in view of the actual cost of running the system in other places. The cost for repairs, as experience with the system proves, is limited to providing new linings, occasionally, for the firebox, and is merely a nominal one.

The committee proposed, among other questions, the following:

(*a.*) Can the rooms be heated and ventilated, when the warm air openings and the foul air exists, are near each other, and on the same side of the room—specially when situated near either end of the room?

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*Our apparatus is now used in one Ann Arbor School Building.—N. & S.

In other words, will not the warm air current, by making a short circuit, pass out of the cold air vent immediately, without distributing itself over the room?

The committee were taken into a room, constructed as in the case supposed. The experiment consisted in sending a puff of smoke from a cigar along the surface of a table, situated in the end of the room farthest from the warm air and foul air openings. The smoke, after reaching the edge of the table, fell, in a condensed form, to the floor, and keeping in its solid form, was rapidly drawn to the foul air vent. This showed that air was being constantly drawn from the parts of the room most remote from the foul air exits. The incoming warm air current, instead of mingling with the outgoing one, rose and spread itself evenly over the room. As the cooler and heavier air was drawn out the upper layers of warm air gradually settled. This resulted in a uniform rise of temperature throughout the room, as shown by the thermometer, when placed on the floor at different points.

(*b.*) Is the air, coming from the warm air flues, *burnt* air, and oppressive to those sitting more directly in the current?

Your committee sat for some time near a warm air flue, and directly in front of it, when the thermometer indicated 80° Fahrenheit. We could not perceive that the air had any of that burnt or stifling smell, so noticeable when one is in a tight unventilated room, and near an intensely heated surface. The air, flowing in from the flue, moderately heated, although the temperature was high, did not seem to have lost its good qualities. Upon going into the furnace room we found that the air in passing over the furnace did not come in contact with the iron incasing the firebox. But between the fire and the current of air to be warmed were two surfaces of iron, separated by several inches; between these surfaces was a volume of air; this air kept the outer layer of iron from becoming intensely heated. Hence, the current of air passing over it could not become so, and the life of the air remained in it.

(*c.*) Did the Ruttan-Smead furnaces fail to satisfactorily heat the school building at Fostoria?*

After a most careful inquiry, your committee became satisfied that they did not. The heaters were said to have been discarded, by the Board of Education at Fostoria, on account of their lack of durability. The facts show that in the basement of the High School building at Fostoria there is but a limited space in which furnaces can be set, the remainder of the basement being used for other purposes. The Board required the Ruttan-Smead company to heat the building—an eighteen room building, with high ceilings—with *two* furnaces. The company attempted to do it; putting in furnaces of a different pattern from their regular make, and built specially for that building. The furnaces were not large enough for the building. The effort to force the furnaces to heat beyond their capacity ruined them. After four year's use, under such circumstances, the furnaces were taken out. That this apparent failure was not a real one, is evidenced by the fact that three persons, who were members of the Board of Education at Fostoria, when the furnaces where in use in the Union School building, and who, subsequently, were members of the Board of Trustees of the M. E. Church, at the same place, voted to put the Ruttan-Smead system into a church building, then being erected for the Methodist society; this building being one of the largest and finest in the city.

We were unable to find any other point, where this system has not given entire satisfaction.

Your committee therefore say, that having examined the system of heating by steam, and also by warm air furnaces, we believe that the Ruttan-Smead System of Warming and Ventilating, is the one best adapted to secure both warmth and ventilation. We also find that the cost per year for fuel is much less by this system than by any other, and that the outlay for repairs is not so large. Your committee therefore recommend its adoption, in a modified form, for use in the central school building in this place.

Respectfully submitted,

W. S. Haskell.
W. M. Tuller, M. D.,
Committee.

Bowling Green, O., July 1, 1885.

W. H. H. Barton, Brockton, Mass.: La Porte, Ind., October 21, 1885.

Dear Sir,—In reply to yours of the 19th inst., will say we are heating the high school building here with Ruttan-Smead Furnaces, they have given *excellent satisfaction*, could not think of using any other. I believe they are the best for large buildings. Ours is an old building, it has not the entire or complete Ruttan-Smead system. The firm do their work *well* in every particular. I think them very reliable, and will do as they agree.

Very respectfully,
L. D. Webber.

Mr. W. H. H. Barton, Brockton, Mass.: Goshen, Ind., October 23, 1885.

Dear Sir—Yours in relation to Ruttan system of heating, as put in by Messrs. Smead & Co., of Toledo, Ohio, received, and in answer we have to say that it is without question the best heater and ventilator in use. It will warm your building perfectly, and at same time give you perfectly pure air without opening doors or windows. Messrs. Smead & Co. *did more for us than we expected, and more than they agreed to do by contract.*

Yours, etc.,
John J. Freeland, *Secretary.*
Frank A. Hascall, *Treasurer.*
Aaron S. Zook, *President.*

W. H. H. Barton, Brockton, Mass.: Kendallville, Ind., October 31, 1885.

Dear Sir,—Yours of October 19, at hand, in reply, will say to questions asked us, that we are delighted with Ruttan-Smead system as introduced by them in our public school building. *It is a perfect success, gives perfect satisfaction to teachers, pupils and janitor.* We can have, without any effort, any desired temperature to 75°. The company did their part *better* than they agreed to; you need have no hesitation in trusting them.

Yours truly, H. A. Moyer,
Secretary Kendallville Board of Education.

See East Saginaw Report, page 54.

*As reported by "Agents."

TRENTON, TUSCARAWAS Co., OHIO, March 18, 1885.

MESSRS. ISAAC D. SMEAD & Co., Toledo, Ohio:

Gents,—Your system of heating and ventilating buildings has been in use in the new school house in this village, since the 5th day of January last.

The continuous and extremely cold weather since that time has given us the best kind of an opportunity to test the merits of your method of heating and ventilating, and we do not hesitate to say that it is the best in use.

Quite a number of our citizens were very doubtful about the expediency of putting furnaces into the new school building, and some of them sneered at the ventilation theory of the Ruttan-Smead Co., but all are now well pleased, and many are enthusiastic in commending it.

Your system of heating and ventilation is to be especially recommended for the following reasons:

First.—It cannot fail to make an equable temperature of from 65 and 70° in the coldest weather.

Second.—The ventilation is so thorough, that the usual languor in scholars and teachers, toward the noon and evening recesses, is not perceptible at all.

Third.—The floors are always warm, and hence teachers and pupils do not suffer with cold feet.

Fourth.—The cost of fuel is not greater than it would be for stoves to heat the same number of rooms, and gives much better results.

Fifth.—The services of a skilled engineer or janitor are not necessary, as anyone who *knows enough to make and keep up a good fire,* and regulate the cold air doors, is capable of taking care of these furnaces.

Sixth.—There are no pipes of any kind imbedded in masonry, and in case repairs are at any time necessary, any good ordinary mechanic is capable to make them.

Seventh.—The apparatus is simple in design, philosophical in principle, more durable and economical than all others that attain the same results; and, in short, is just calculated to fill a much needed want in all our public buildings.

Wishing you that success which your apparatus deserves,

I am, very respectfully yours, JNO. D. CUNNING,

President of Board of Education, Warwick Township, Tuscarawas, Co., Ohio.

REPORT OF COMMITTEE ON HYGIENE, ALBANY, N. Y.

To the Board of Public Instruction: ALBANY, May 18, 1885.

Your Committee on Hygiene herewith presents the following report:

In the discharge of our duty we have personally visited every public school building in the city, and have examined the same with reference to location, seating capacity, drainage, ventilation, means of heating, and the condition of outhouses and latrines.

While we do not contemplate the presentation of an exhaustive report, covering all the above points, we shall call attention to those matters which, in our opinion, demand most urgently the attention of the board.

In the opinion of your committee the ventilation and drainage of our school buildings bear most directly upon the physical, mental, and moral health of the scholars, and are therefore the most important of all the sanitary needs of the schools. * * * Air and light are the birth-right of all, and it is certainly unjust to discriminate in the matter of healthful locations for any special part, section or class of our growing city.

In the matter of heating and ventilating your committee find ample room for improvement. Of the twenty-four school buildings under the charge of the board only six can be said to be really well heated. The furnaces and stoves placed in the buildings under a contract system which looks to the cheapest article only, no matter what its sanitary qualities, are entirely inadequate to do the work needed, and are generators of discomfort rather than of comfort.

In school No. 5, on North Pearl street, a new school house, the hot-air flues are so ridiculously small that the rooms can only be heated by a great consumption of fuel, and by extra night work on the part of the janitor. In certain rooms in which the flues have been enlarged, a heightened temperature of at least ten degrees has been attained. The flues should be enlarged throughout the entire building.

Ventilation and heating are so inseparably connected that where one is inadequate, the other must be. Only seven school buildings are even fairly ventilated, and in the majority of the buildings there is no ventilation whatever other than the old and utterly insufficient method of opening flues near the ceilings, or by means of so-called air-shafts, which are of no earthly use.

School No. 11, on Madison avenue, one of the best school buildings in the city, is well supplied with steam-heating apparatus, but is entirely devoid of healthful ventilation.

School No. 21, on Clinton avenue, as originally ventilated, appears to have been in good condition, but for some cause, which your committee have not been able to ascertain, four rooms in the building occasionally pass their vitiated air through those directly above!!! The heating capacity of this building is not sufficient, and in six rooms during the prevalence of westerly winds, in zero weather, the temperature is never above 50°.

In this connection your committee would report that they have listened to many different plans and propositions relative to improved heating and ventilating methods, and have inspected certain systems suggested and recommended. After careful investigation, however, they unanimously and unhesitatingly recommend what is known as the Ruttan-Smead system as by far the best method of securing efficiency in these very necessary sanitary departments.

This system secures absolute uniformity of temperature, economy in consumption of fuel, desirable quality of air, natural and healthful summer heat, complete control of the temperature by the teacher, and a supply of fresh air always entering the room.

In company with members of the Committee on Construction and Repairs, your committee visited the public school building located at Fultonville, New York, and carefully inspected the workings of the Ruttan-Smead system of heating and ventilating there used.

The Fultonville school building, visited by your committee, is exposed to sharp winds on all sides, and yet was perfectly heated and ventilated. This being so, *it is obvious that in the most exposed school buildings under control of the board, this system would be found entirely adequate and satisfactory, and your committee urge that at*

least in schools Nos. 21, 20 and 12, which have the most exposed surface of any of our buildings, this Ruttan-Smead system be at once introduced; adding also that in the case of No. 21 the windows on the western side, now in poor condition, be made air-tight.

Your committee would offer these suggestions for special consideration: First, that the janitors of the several school buildings be placed under the direct supervision of the superintendent of buildings, who, being himself responsible to the commissioners, would see to it that proper care and attention be given to each school building by the janitor in charge.

Second, That all plans for new school buildings be submitted to the Committee on Hygiene for suggestions relative to sanitary arrangements and regulations.

Third, That hereafter a much larger proportion of the amount appropriated in each year's budget for repairs and heaters be devoted to heating, ventilation, drainage, etc., and thus gradually to put the buildings under control of the board in complete sanitary condition.

O. E. Wilson,
Peter J. Flinn,
Herman Bendell.

From St. Joseph (Mo.) Evening News.

The Steinacker school building, which has just been completed, at the corner of Second and Lewis streets, is one of the most completely appointed school structures in the West, and is very justly the pride of the residents of that part of the city.

The building was first used for school purposes yesterday. This morning the members of the school board proceeded to this school in a body to inspect it, more especially with a view of the heating and ventilation. All the members were present except Mr. Hull, and a thorough test was made. There has been some difference in opinion among the members of the board as to whether warm air or steam was the best system of heating public buildings.

The board adopted the Ruttan-Smead system of furnaces, or air warmers, and warm air for this building, and the members were, of course, anxious to know just how it would operate. The board visited the building at 9 o'clock, just as school was commencing, and at once commenced their task. The first test was that of heating. The thermometer was run up from 70° to 92 in twenty minutes, and during this time Mr. Condit, the agent who put in the furnaces, went to the basement and had the fires shut off. The schools were then dismissed for a time, and the ventilation was then tested. One of the rooms was filled so densely with pine smoke that one could not see from one wall to the other. The ventilating valves were then opened, and the smoke gradually descended in a solid body to the floor, rapidly. In just seventeen minutes from the time the valves were open the room was perfectly clear of smoke. One peculiarity was that the smoke in descending kept in a compact body, and when half out was so dense in the lower part of the room that the seats could not be seen; the air above was so clear that one could breathe freely and without the slightest suspicion that there was smoke in the room. The temperature proved to be almost absolutely uniform, for the thermometer hung near where the air entered, and on the opposite side of the room only differed 1½ degrees. The rooms can be warmed to any temperature desired, it being so arranged that no matter how hot the fires below, the warm air can be shut off, and cold air let on at any time by the teacher, so that fresh air is constantly flowing into the room. On Saturday last, when the thermometer was 27° below zero, the rooms were warmed to 87° above in about two hours. Miss Albin, the principal, and the other teachers say they have never occupied more pleasant or comfortably heated rooms.

The board held an informal meeting at the school house after this examination, with Mr. John M. Armstrong in the chair, and voted the thanks of the board to Mr. Condit for the satisfactory manner in which he had introduced the apparatus, expressing satisfaction with the operation of the system.

The Committee appointed by the

BOARD OF EDUCATION OF EAST SAGINAW, MICHIGAN,

to select a system of warming and ventilation for the new school building about to be erected for that city, made the following report, which we copy from the *Saginaw Herald* of March 20th, 1884:

To the Honorable, the Board of Education of the City of East Saginaw:

Gentlemen,—Your joint committee on Building and School Houses would respectfully report that, as directed at the special meeting February 27th, they have investigated somewhat fully the matter of heating and ventilating, by the use of warm air furnaces, and also by steam. As known to this board, neither method has been altogether satisfactory as applied in our schools, so a portion of the committee visited Detroit and Toledo, where steam and "Ruttan-Smead" method of heating and ventilating are in successful operation.

In Detroit we visited the Irving School House, a twelve room two-story building, which is the best equipped and heated of any of the large school buildings of that city. The plan of heating is by steam, using direct and indirect radiation. Indirect radiation is secured by coils of steam pipes located in recesses left in the outside walls beneath the windows, and cased in by galvanized iron. The fresh air reaches the room through gratings in the wall up through the heated coils and out through similar gratings placed just under the window sills. Direct radiation is obtained by piping fastened to the wainscoting under the blackboard in the most exposed corner of the room. In coldest weather, both means of warming are used; in ordinary weather only the indirect. The vitiated air is removed from the rooms by openings into ventilating shafts similar in construction to those in our High School. It cost the School Board, in running order, about $4,000, as certified to us by the Secretary of the Board. It requires *something over one hundred tons of hard coal to run it each year.* In Toledo we visited a nine room building, warmed by steam, where seventy-five tons of hard coal are required each year. This apparatus also cost $4,000.

Those members of the Board present at the meeting of February 20th, will remember that an agent of the "Ruttan-Smead" method of heating and ventilating was present and explained at length the workings and application of this system. To observe this system in practical operation, we were taken in Toledo to

the Humboldt School, where we found the system adapted to six rooms of this twelve room three-story building. The remaining six rooms of the twelve room house were warmed by a furnace similar to those in our High School.

The "Ruttan-Smead" system differs from all ordinary methods of warming by warm air furnaces, in that it requires ventilation to be able to heat successfully. For this purpose it uses a very large tubular furnace that, as in the use of steam, a large warming surface may be presented to the fresh cold air. In ventilation, instead of removing the vitiated air from the room at one point, it takes it out through openings in the base boards communicating directly with the space beneath the floors and between the joists, from which it is drawn by an ample ventilating stack into the open air.

In this twelve room building we had an excellent opportunity to compare the old and the improved methods of warming and ventilating, as the Supervisor of Buildings and the teachers courteously permitted us to visit every room, going in and out from one side of the house to the other, arranging dampers, shutting doors, and questioning teachers as to the workings of each furnace. The morning of our visit, there was a strong southwest wind and the thermometer registered eight degrees below zero. We were some two hours about the building. The result of our observation and study may be stated as follows:

1. That in the room warmed by the "Ruttan-Smead" furnace the temperature was uniform in degree in every part, with no perceptible chilling current of air at the level of floor.

2. That the rooms were excellently ventilated, being free, as far as we could discern, from that close, sour, enervating odor so common in ordinary school rooms.

3. That by the use of a delicately adjusted air-meter, we observed the supply of fresh warm air was sufficient to fill the room every twelve minutes. By applying the same means of measurement to the ventilating vent in the base, the out-flow of vitiated and cold air corresponded in quantity to the supply of fresh warm air.

4. That the method of removing the foul air at so many different points in each room, virtually prevents drafts and reduces to a minimum the breathing over again by the pupils of vitiated air.

5. That by means of a valve or door in the warm air flues, each teacher can regulate the quantity of inflowing warm air, but cannot prevent the sufficient supply of pure air, thereby making it unnecessary to lower windows.

6. That from the Superintendent of Schools and Supervisor of Buildings we learned for the year 1882–83 *that less soft coal was consumed in the "Ruttan-Smead" furnaces than hard coal in the other furnaces*, while ventilation was secured in one set of rooms, but not in the other; that the attendance was better on the "Ruttan-Smead" side, on the same enrollment, than on the other, and that the schools were not dismissed on the one, and were on the other, and for a time equal to thirty days for one school. We submit herewith their certificates.

OFFICE OF SUPERINTENDENT OF SCHOOL BUILDINGS,
TOLEDO, Ohio, March 5, 1884.

MR. J. C. JONES:

Dear Sir,—For year beginning September 1, 1882, and ending June 30, 1883, the following amounts of coal were used in Humboldt School: six rooms, heated by ——— furnace, took 56 tons of hard coal, at $6.50 per ton; six rooms, heated by Ruttan-Smead furnaces, took 46 tons of soft coal, at $2.80 per ton.

AUGUST OECHSLER,
Superintendent of School Buildings.

J. C. JONES, Superintendent of Schools, East Saginaw, Mich.: TOLEDO, Ohio, March 1, 1884.

Dear Sir,—In answer to your inquiries, I would say we have a twelve-room building, six rooms heated by Ruttan-Smead systems, and six rooms heated (and poorly heated) by the —— furnace. An accurate account was kept for the year 1882-83 of the coal furnished each side; it took less tons of soft coal for the Ruttan-Smead side than of hard coal for the —— side. The Ruttan-Smead side was not only heated, but what is of more importance, ventilated also. The —— side was not well heated; schools having to be dismissed enough to amount to a dismissal of one school for at least thirty days. It costs two hundred and thirty-six dollars less for the Ruttan-Smead side than for the —— side. The attendance, based on same monthly enrollment, was ten better for each day on the Ruttan than it was on the —— side. I have no hesitation in saying that I consider the Ruttan-Smead system the best of any heating apparatus we have, and we have in some of our buildings steam heating by direct and indirect radiation. What our Board thinks of it may be seen from the fact that they have ordered it to be put up in four buildings to be erected this summer, in addition to those in which we already have it — seven in all.

Very truly, J. W. DOWD,
Superintendent and Clerk Toledo City Schools.

Learning that these furnaces were in use in the four State Normal Schools of Wisconsin, we directed the Superintendent to write the Secretary of the Board of Regents controlling them, the Hon. W. H. Chandler. His letter is herewith appended:

J. C. JONES, Superintendent of Schools, East Saginaw, Mich.: MADISON, Wis., March 5, 1884.

Dear Sir,—Yours of March 3 is at hand. I very cheerfully give you all the information I have relating to our experience with the "Ruttan-Smead" heating and ventilating system.

1. As to durability and efficiency, we have found the furnaces and system all that was claimed for them. The expense for repairs and the renewal of parts is scarcely anything. A grate has to be renewed occasionally, that is all.

2. We can depend upon their efficiency with absolute confidence. Whatever the temperature outside, that of the school rooms is comfortable. And this means that the rooms are ventilated as well as heated, for it is impossible, as you know, by this system to keep a room warm in cold weather, unless the air is frequently changed.

3. We have no complaints now of prevalent headache, as formerly, with steam and other systems. Our school houses, with warm corridors and rooms, are more comfortable than most homes, and no weather but

blizzards which intercept going to and from, affects our attendance. They do ventilate, as claimed, wherever the system is properly planned and executed.

4. As to economy in fuel, we use very much less fuel than with other furnaces, or with steam. In every case now our rooms are equally heated, and our basements are not red hot and the rest of the building cold. We do not prefer steam, which is liable to freeze up and fail at the time when we can least afford to have it do so.

We have this year completed the substitution of the "Ruttan & Smead" for other systems in our normal school buildings. We have had this system on trial now for five years, and the furnaces show no signs of failure. We are more than pleased with the system in all respects, and congratulate ourselves we are now to have a long rest from the trouble and expense of changing heating and ventilating apparatus.

Very respectfully yours,

W. H. CHANDLER,
Secretary Board Regents Normal School.

The cost of placing this apparatus in our new proposed building will be one thousand eight hundred and fifty dollars, with guarantees that if it does not work successfully, it shall be removed and money refunded. From all herewith presented, and from what we have learned by personal investigation, and for the further reason that it is less in cost than steam by one-half, and uses the cheaper fuel, we recommend its adoption as a means of heating the new building, and that the Secretary enter into a contract for the same with the proprietors of the system, Isaac D. Smead & Co., Toledo, Ohio, on the basis of their proposition herewith submitted. All of which is respectfully submitted.

JACOB CHRISTOPHER,
O. H. HETHERINGTON,
FRANCIS BRUCKER,
S. S. LINTON,
W. G. MAIER,
Joint Committee on Buildings and School Houses.

Dated March 19, 1884.

Insp. Lawrence moved that the report be received and filed, and the recommendation therein contained adopted.

Carried as follows: Ayes—Insps. Brucker, Camp, Christopher, Hetherington, Lawrence, Linton, Maier, Newton, Seely, and the President. Nays—None.

After apparatus referred to above had been used one winter, the *East* Saginaw Board of Education have contracted with us to remove steam apparatus from the "Crary" building, and introduce the Ruttan-Smead apparatus, and are also introducing same in a new building now being erected.—The "Houghton."

The Saginaw City Board of Education contracted with us to furnish apparatus for a new building during the summer of 1884, and the following item from their local paper may be of interest:

The board of education contracted yesterday with Isaac Smead & Co. for the necessary heating and ventilating apparatus for the new sixth ward building. The contract price is $1,580. This company put the heating apparatus into the Hill building, and it proved very satisfactory last winter.—*Saginaw Courier.*

RUTTAN-SMEAD SYSTEM OF WARMING AND VENTILATING ON LONG ISLAND.

ISLIP'S NEW SCHOOL BUILDING.

THE village of Islip has recently completed one of the finest and most eligible school buildings to be found anywhere in the state of New York. * * *

By far the most important thing the Building Committee had to consider was the heating and ventilation of the new building. Various systems were investigated, and numerous buildings supposed to be perfect in this respect visited, among them the school building at Greenport, where steam is used. A physician who visited this school says that he found it very poorly ventilated, and the air in the rooms so foul that it was a shame to compel the pupils to breathe it.

After numerous interviews and much inquiry and correspondence, the committee selected as best the Ruttan-Smead system of Isaac D. Smead & Co., Toledo, Ohio, and they are satisfied that this choice was a wise one. The system acts upon the principle that it makes a house breathe just as a man does. It is so arranged that all the air in the building must enter a warm air room in the basement and become sufficiently warm before entering the school rooms, where it makes its exit from a ventilator along the floor, under each window, from whence it is conducted to the foul air room, where it makes its exit to the foul air stack. The temperature of the rooms whether at floor, ceiling or windows, varies only two or three degrees by actual test, and it is found by testing with an air meter that the total volume of air is changed once in every eleven minutes.

Thus the air is just as fresh as it is out of doors; there is no odor, and at 4 o'clock the air is as pure and fresh as in the early morning hours. It has not been necessary to open a window for ventilating purposes since the school house has been in use. The system costs less than steam, and is in every respect the most perfect known. Dr. Dio Lewis, the famous medical writer and authority, recently visited this school building and thought it admirable in every particular, and especially as far as the heating and ventilating were concerned. He was skeptical on this point before his visit, and he said he was convinced, from what he had seen, of the superiority of the system adopted by the building committee.

The tests applied by the makers to their system were severe ones. One was to close all the windows, doors, and registers, and to fill a room with dense smoke. In twenty minutes the room was free of smoke, and the air as pure as that outside, and this was all done without opening a door or window. There are 10,000 pounds of iron in the furnaces. They are heavy, simple, and will last for years. The Superintendent of construction of schools of New York City was invited to inspect the school building, but with that characteristic indifference born of political life he preferred to stay at home.

In all New York City there is not a properly ventilated school building, and School Commissioner Devoe recently said that something must soon be done to remedy this defect, and that death frequently occurred from poor ventilation and overcrowding. We fear New York does not stand alone in this respect. Foul school rooms, breeding the germs of disease and death, are scattered all over the land, a blot on the face of nature, and a standing disgrace to willful indifference of mankind. School Commissioner Douglas Conklin says the Islip school building is the finest equipped he ever visited, and we do not hesitate to add that nowhere can its superior be found.—*Advance Patchogue, L. I., Feby.* 14.

COST OF WARMING SCHOOL BUILDINGS.

IN TOLEDO SCHOOLS.

For winter of 1884–5:

With Ruttan-Smead apparatus	$22.79	per school room.
With steam heating apparatus	52.68	" " "
With hot air furnace	86.25	" " "

IN DETROIT.

With Ruttan-Smead apparatus (frame building)	$25.25	per school room.
With steam heating apparatus (brick building)	54.00	" " "

IN WASHINGTON, D. C.

With Ruttan-Smead apparatus	$24.20	per school room.
With steam heating apparatus	56.00	" " "

ELMIRA, N. Y.

With Ruttan-Smead	$15.50	per school room.
With steam	40.70	" " "
With hot air furnace	37.50	" " "

There are ninety-nine school rooms in Toledo, warmed by the Ruttan-Smead apparatus, nearly as many in Washington.—*Toledo Blade, May* 18.

There are now 127 school rooms in Toledo, warmed by our apparatus—Oct. 1. Isaac D. Smead & Co.

To Whom it may Concern: Elyria, O., May 14, 1884.

We have had in use since the 10th of September, 1883, two No. 8, and one No. 7, Ruttan-Smead Furnace. These furnaces have been used to heat and ventilate a school building. The following statements will show how well the work has been done:

1. They have warmed 121,960 cubic feet of school room, besides frequently allowing heat to escape into the halls. This is equal to ten rooms of 12,196 cubic feet per room, and that is larger than the average school room.

2. They have ventilated these rooms better than I have ever known school rooms to be ventilated in an experience of a quarter of a century in the profession of teaching.

3. They have ventilated equally well the water closets in the basement of the building.

4. For two weeks during cold weather, six observations of the temperature of the High School room, which is 48 x 50 x 16, were made daily, from 8.30 A.M., to 3 P.M. At every one of the sixty observations the temperature was 68° or 70°, F. The thermometer registering the above was about three feet from the floor. A thermometer was placed upon the floor and remained there all day. Six observations were made, and it was 68° each time.

When the mercury was 10° below zero on Monday morning, there having been no fire in the building since the preceding Friday, the fires in the furnaces were built at 5.30 and 8.30 the temperature in all the rooms was 70°.

As our building was new, we started fires every day after entering it, the 10th of September, and we have had but few days this spring when we have not started a fire in the morning.

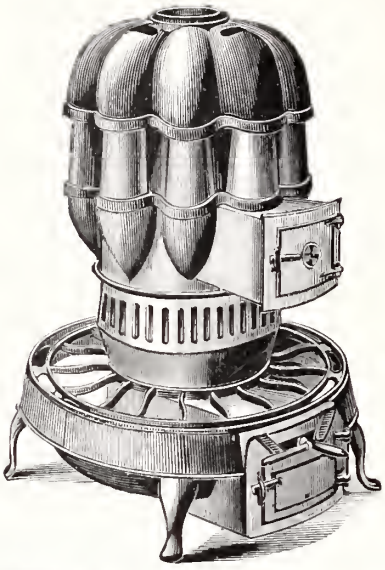
The three furnaces have consumed exactly sixty-three tons of soft lump coal. Ventilating stoves (?) heating the same amount of space, have consumed 70 tons of the same kind of coal, and have poorly ventilated the rooms. We have saved in fuel, gained in even temperature and in ventilation.

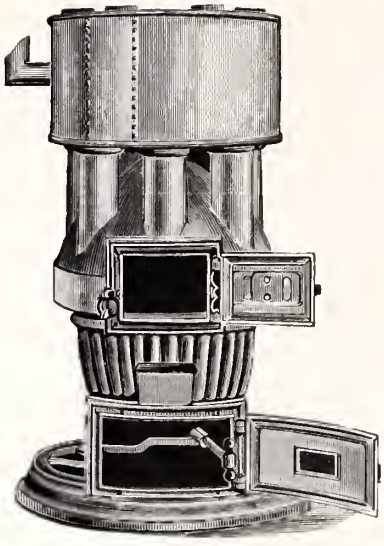
A recent examination into the condition of the furnaces, showed them to be in a good state of preservation, and they need no repairs.

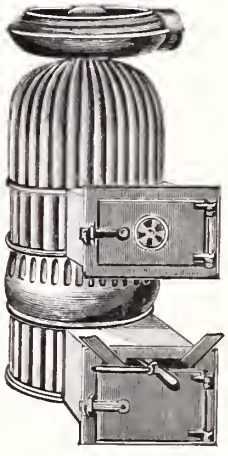
I am convinced from careful observation that the Ruttan-Smead Apparatus will do all that is claimed for it, if the directions are carefully followed, and any careful man of average intelligence can learn to run the apparatus successfully.

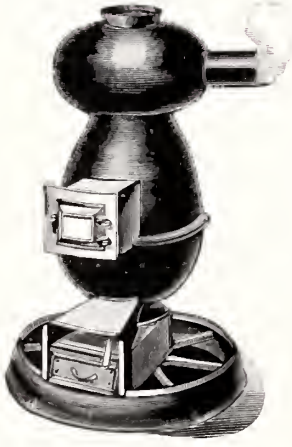
Respectfully,

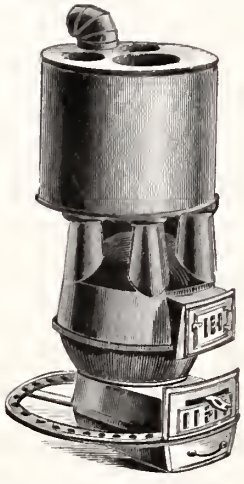
H. M. Parker,
Superintendent of Schools, Elyria, O.

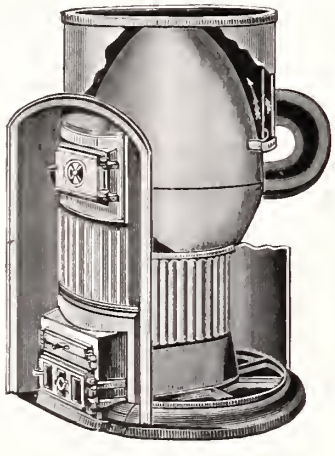


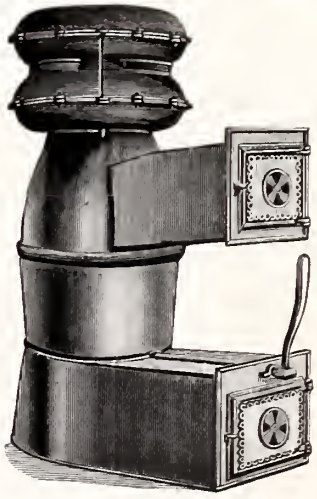








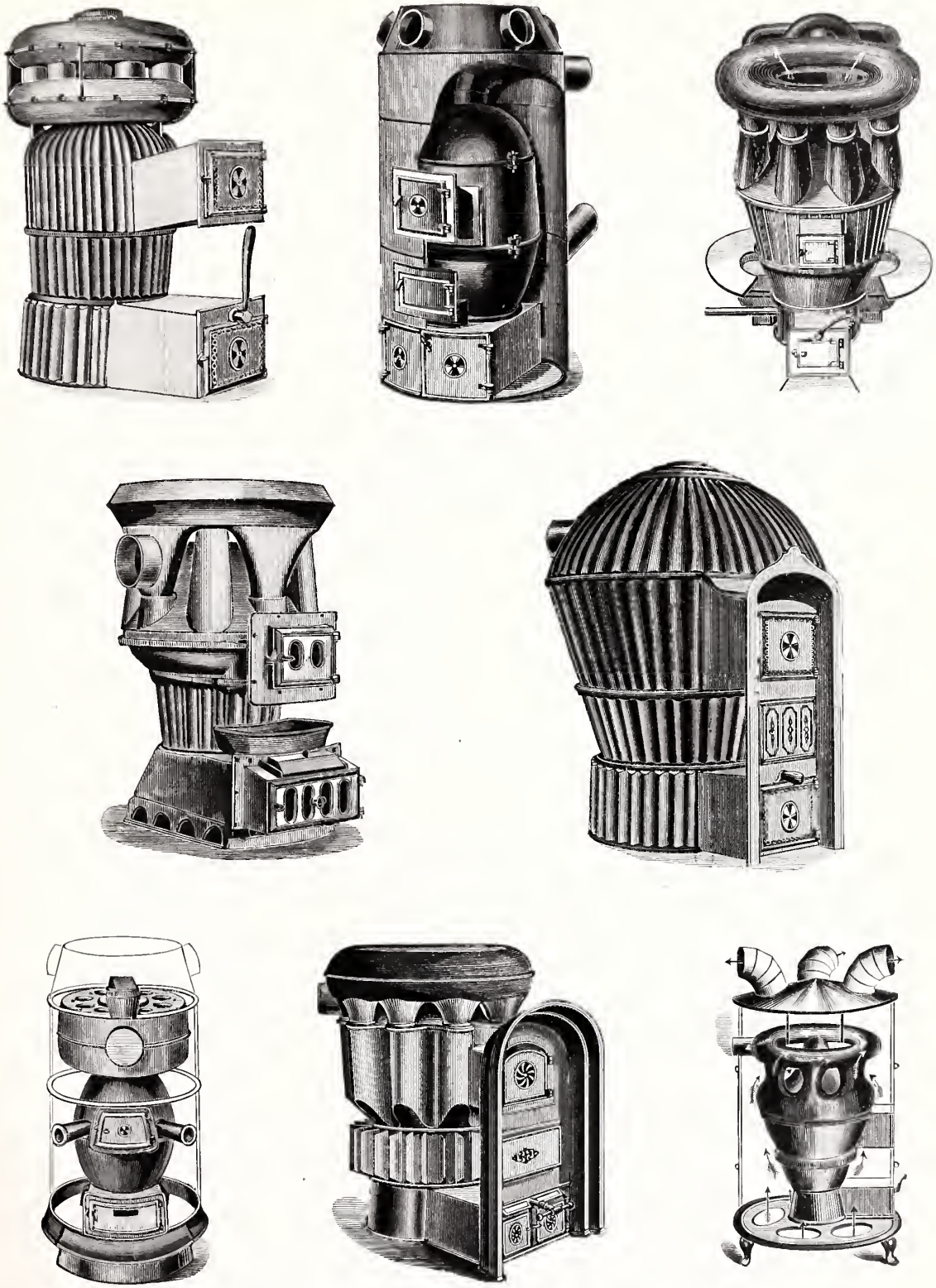




A GROUP OF "HOT AIR FURNACES."

(Which is the best? See page 5.)

(These cuts are introduced here to show the faulty construction common to all "Hot Air" Furnaces.)



A GROUP OF HOT AIR FURNACES.

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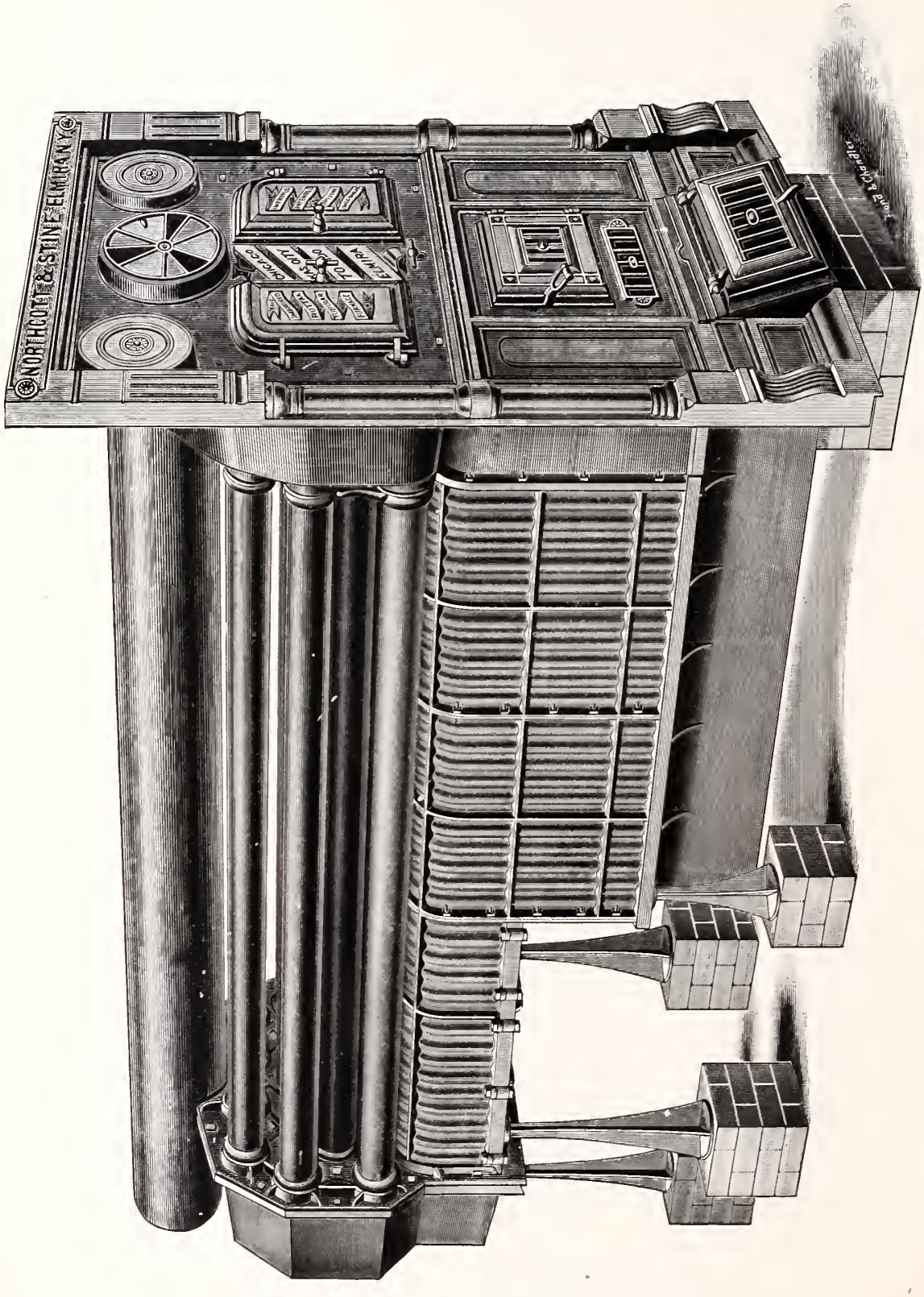
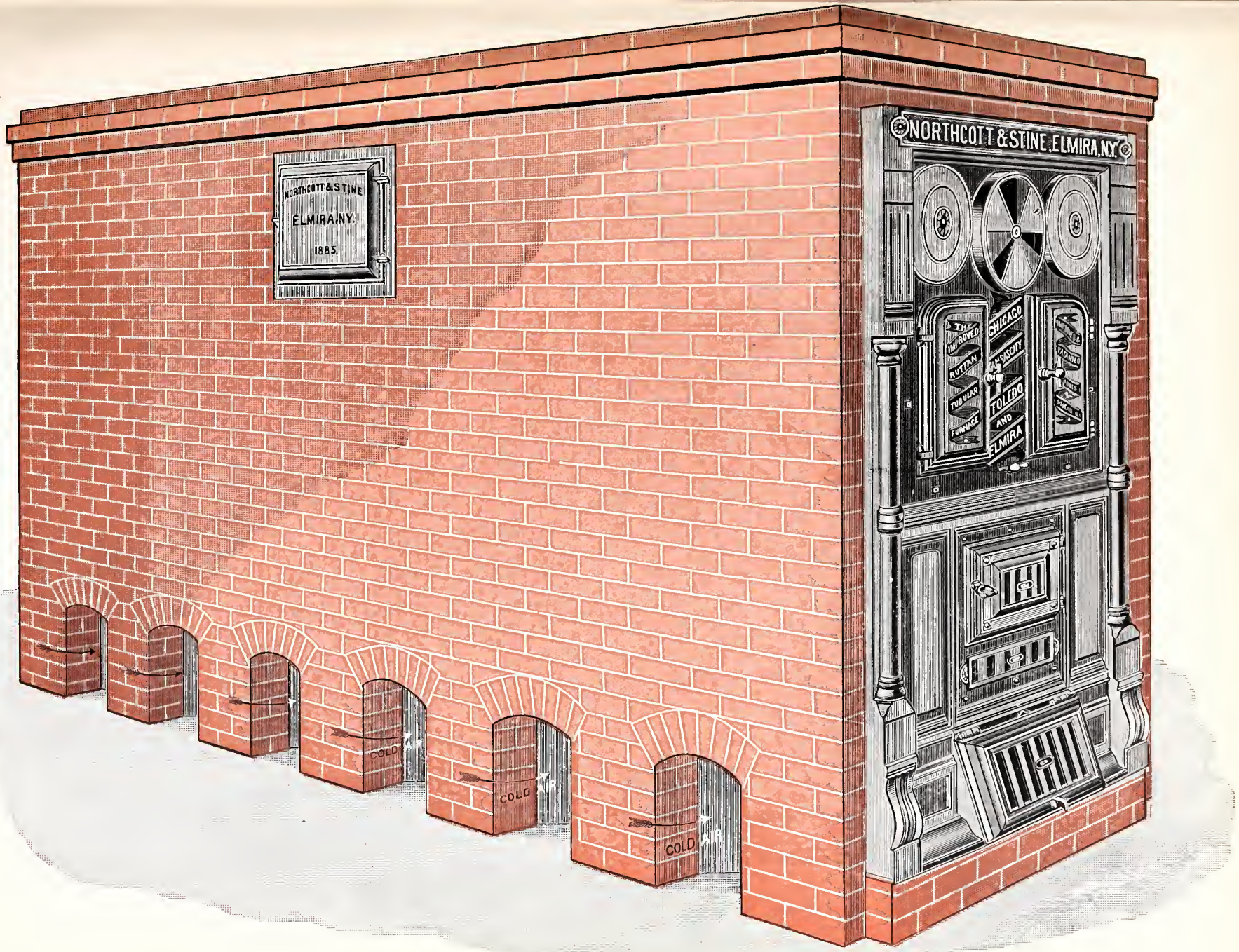


EXTERIOR VIEW OF RUTTAN-SMEAD TUBULAR AIR WARMER.
(1885 Pattern.)

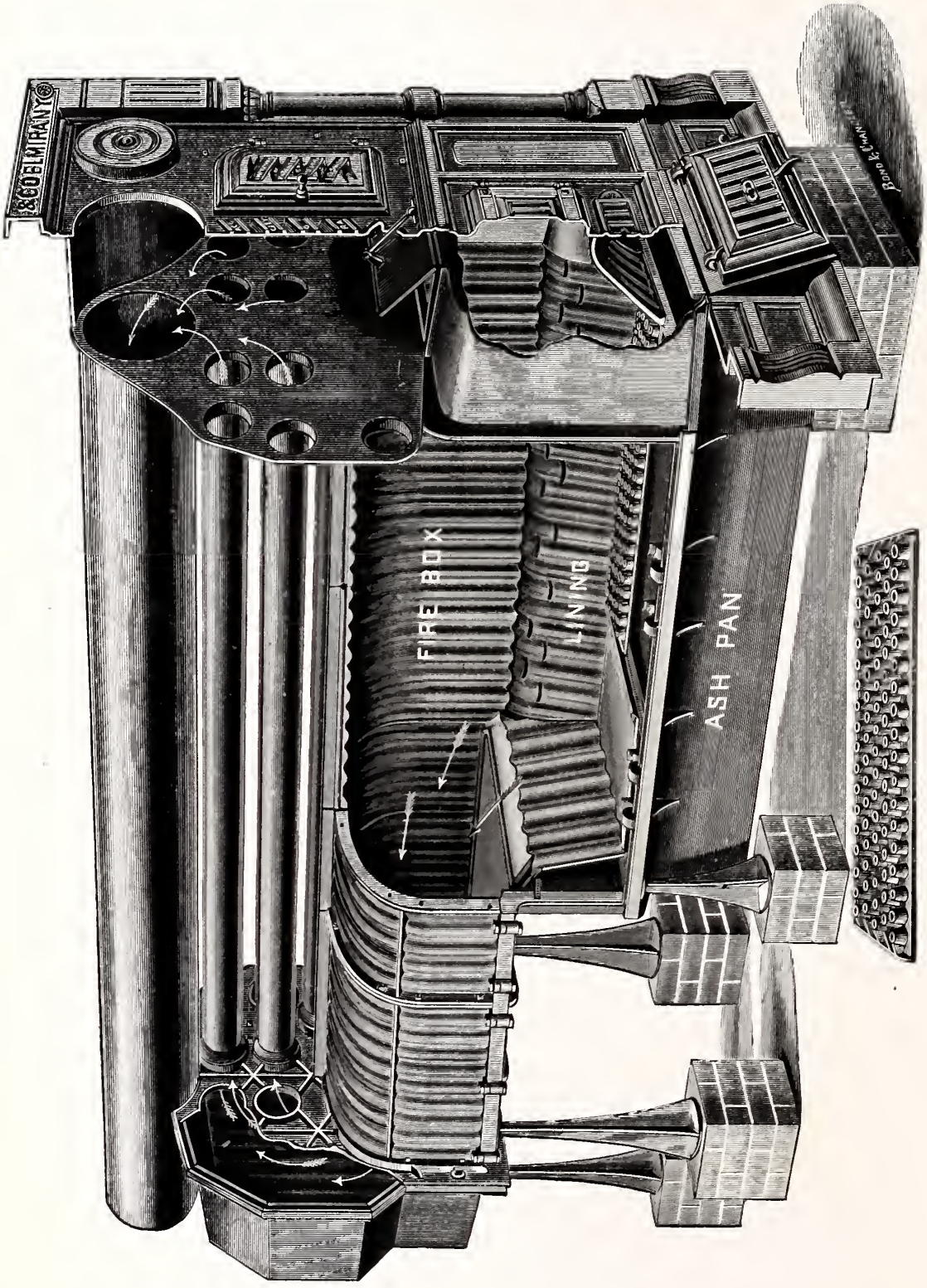
The largest size is thirteen feet long, six feet high, five feet wide, and weighs about *three tons*. (For description, see pages 5, 16 and 20.)



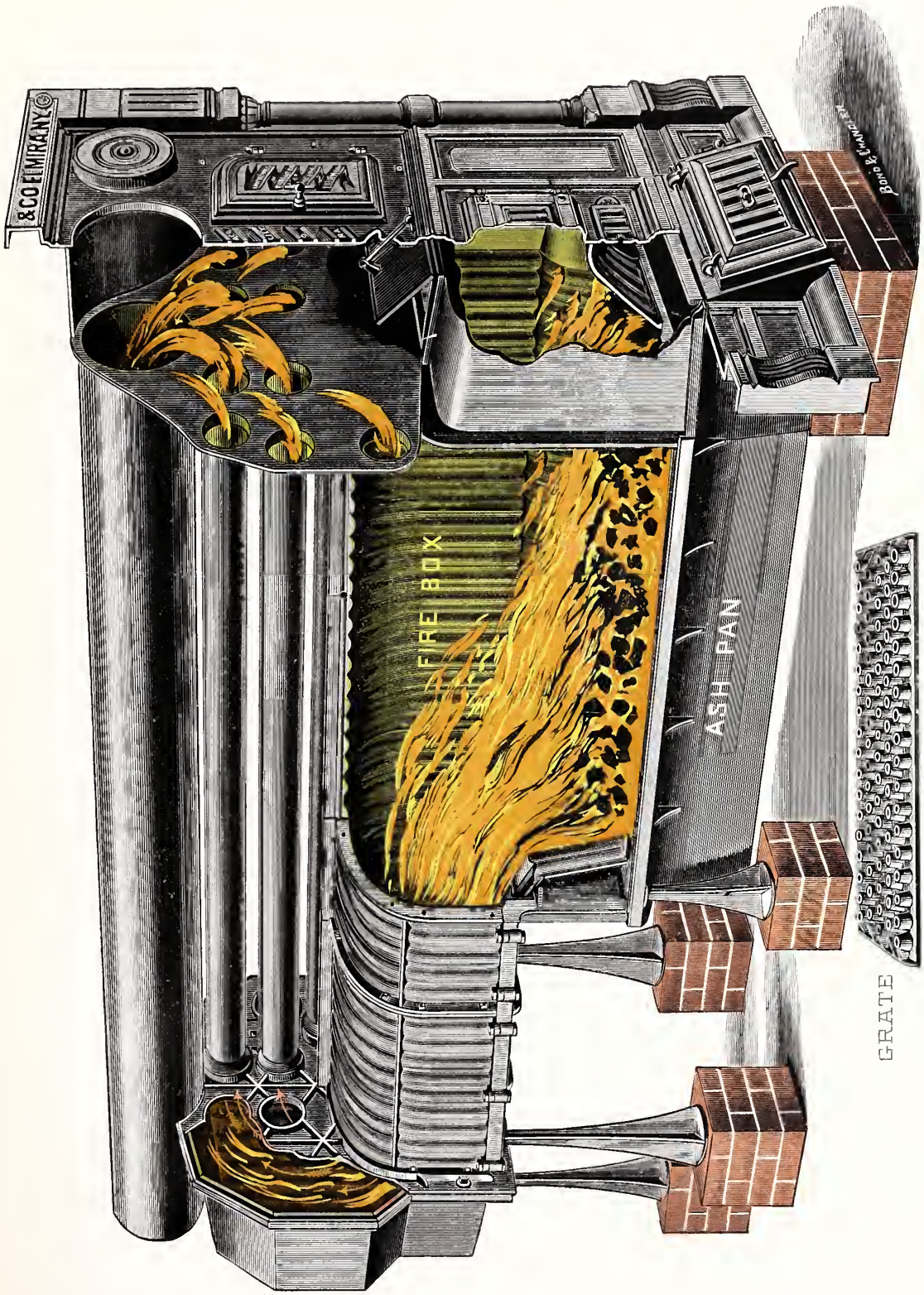
PERSPECTIVE VIEW OF RUTTAN-SMEAD TUBULAR AIR WARMER,

As shown when set ready for use, with openings through side of brick case for entrance of cold air from cold air room

(See isometric drawing on page 74.)



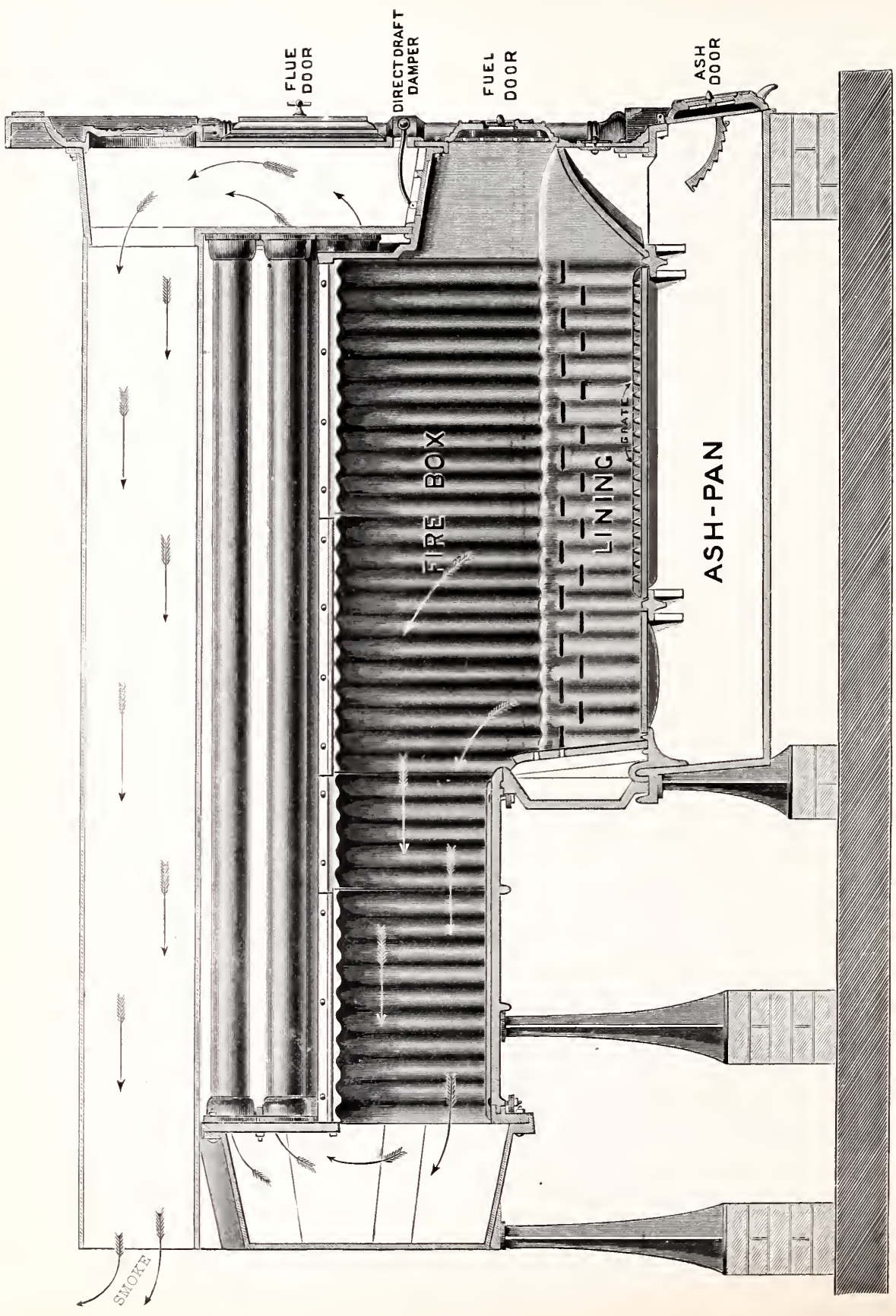
INTERIOR VIEW RUTTAN-SMEAD TUBULAR AIR WARMER.
1885 Pattern.



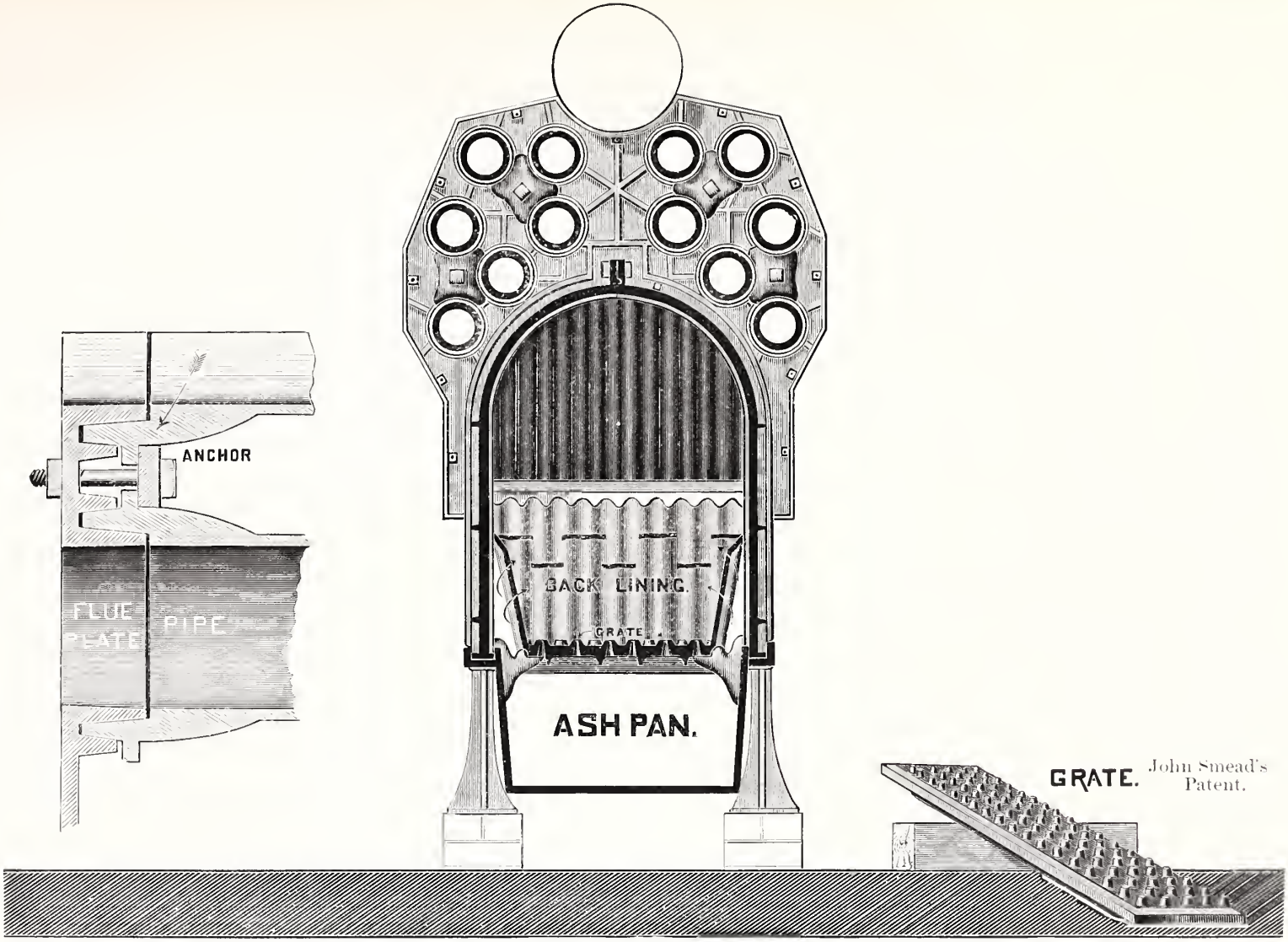
THE RUTTAN-SMEAD TUBULAR AIR WARMER.

(1885 Pattern.)

View showing interior, with fire burning. (With heavy fire, flame will extend entire length of small flues, as shown above.)



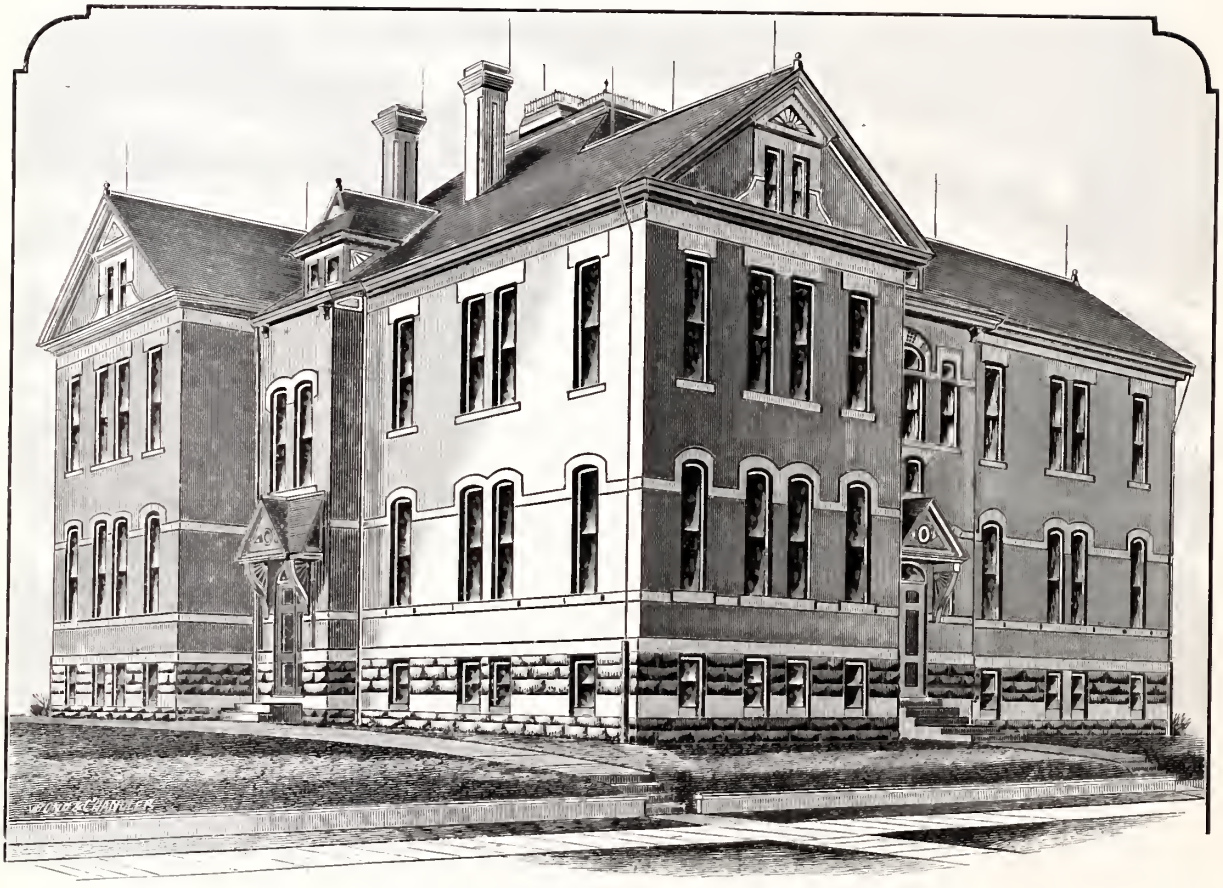
LONGITUDINAL SECTION, RUTTAN-SMEAD TUBULAR AIR WARMER.
(1885 Pattern.)



TRANSVERSE SECTION OF RUTTAN-SMEAD TUBULAR AIR WARMER.

(Represented on page 60.)

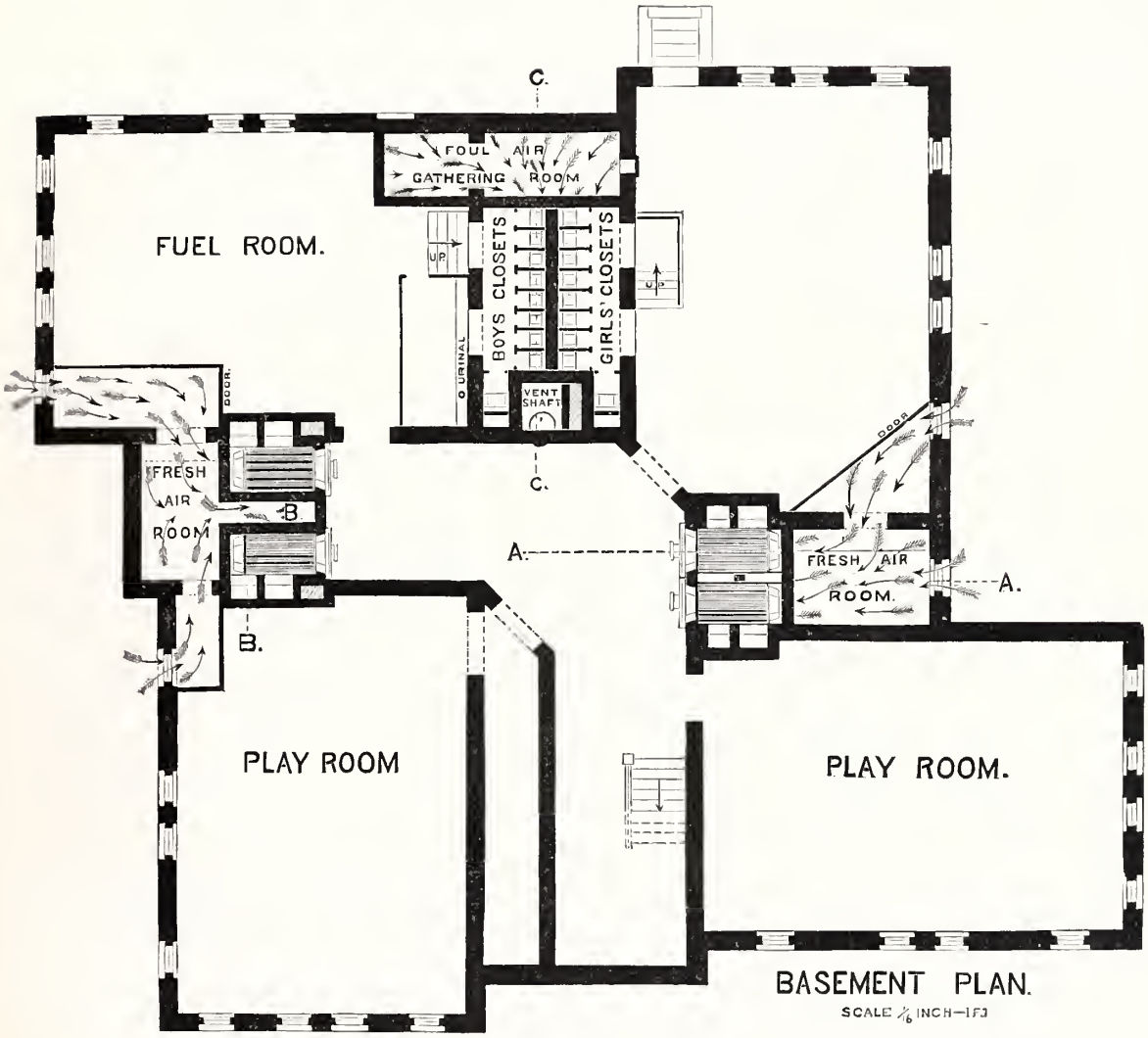
We desire to call especial attention to the patent grate shown above. We paid a large amount for patent and are of the opinion that it is the best grate ever made, for either soft coal or wood.



SOUTH STREET SCHOOL BUILDING, TOLEDO, OHIO.

D. W. GIBBS & CO., TOLEDO, ARCHITECTS.

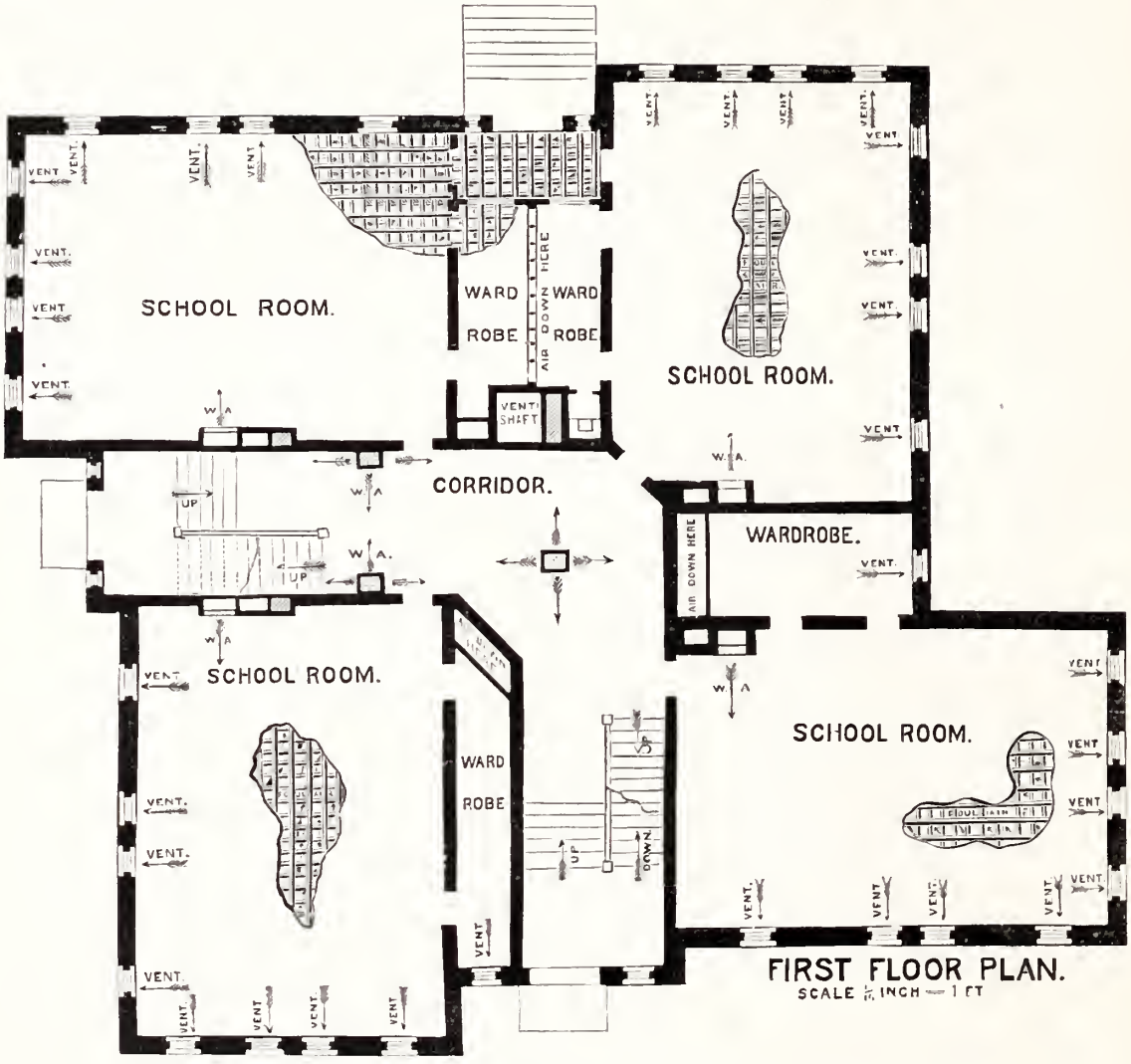
For basement plans, floor plans, sections and instructions, see pages 23, 24, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77.



BASEMENT PLAN SOUTH STREET SCHOOL BUILDING, TOLEDO, OHIO.

Showing Furnaces, Cold Air Rooms, Foul Air Rooms, Smead's System of Dry Closets, Warm Air Flues, Ventilating and Smoke Flue.

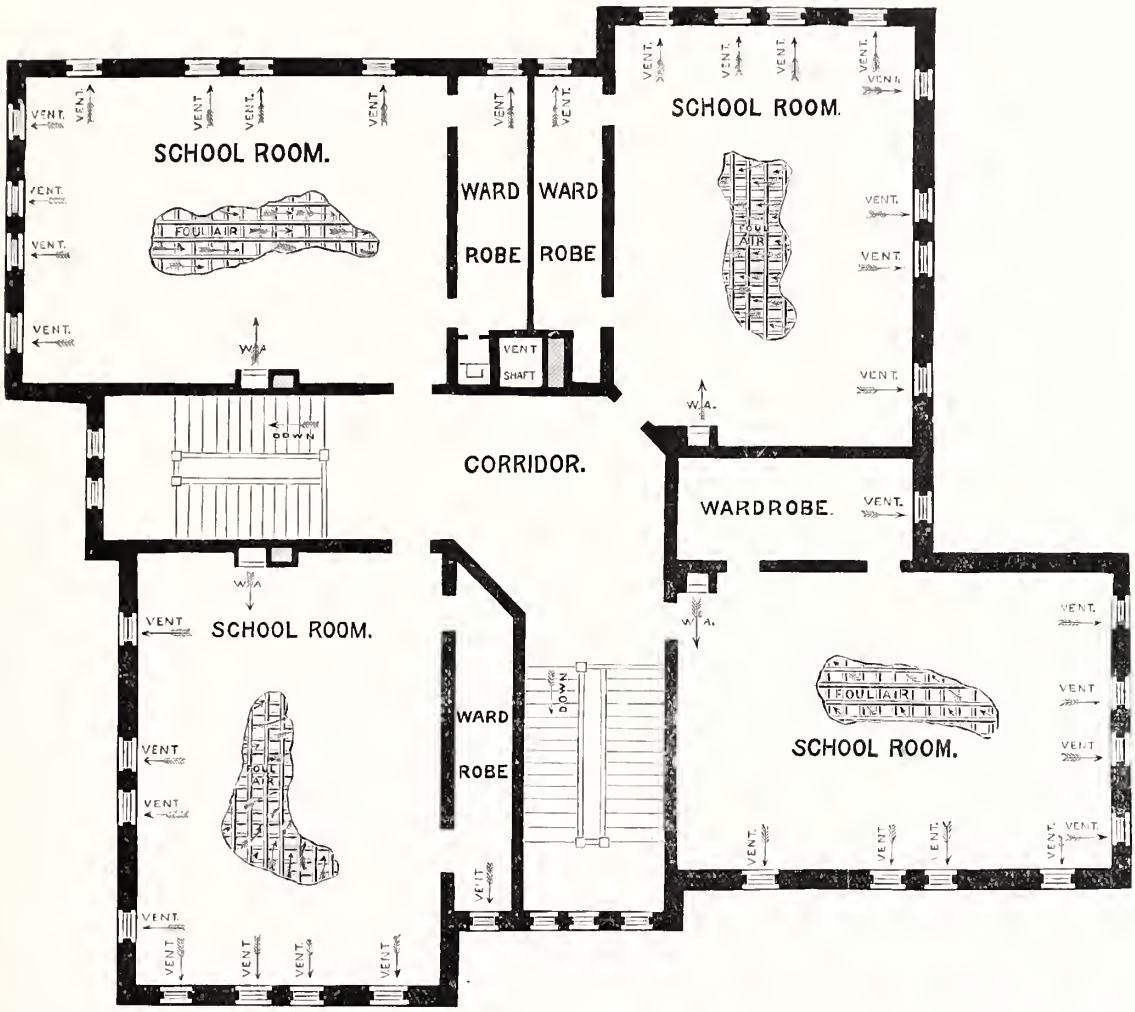
(See pages 23 and 24.)



SOUTH STREET SCHOOL BUILDING, TOLEDO, OHIO.

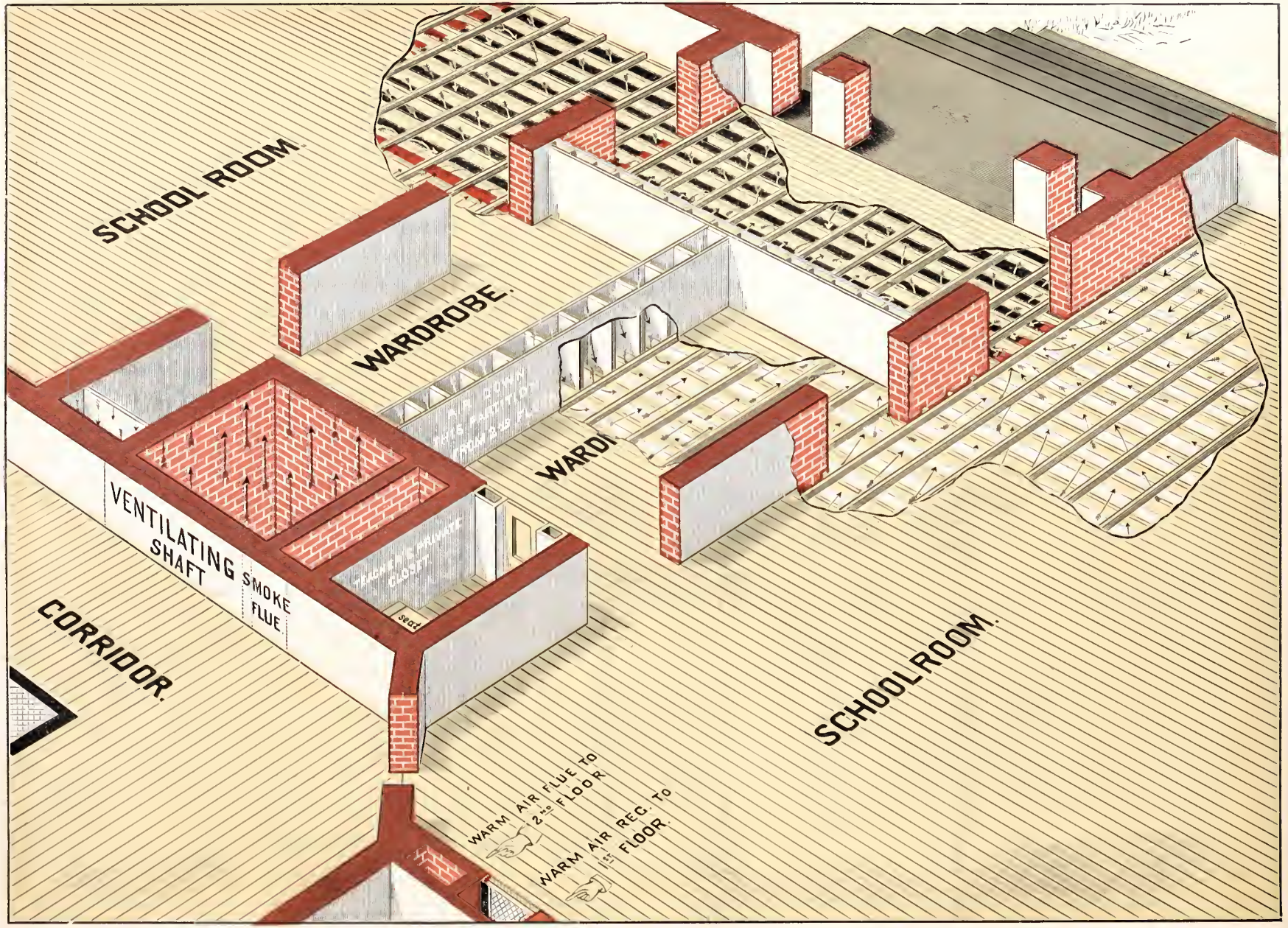
Representing, by breaks in the floors, the passage of air under them; location of main air register in school rooms and corridors, and also location of foul air exits before it passes under floor.

See page 66 for perspective of building, and page 19 for explanation of system of warming and ventilating.



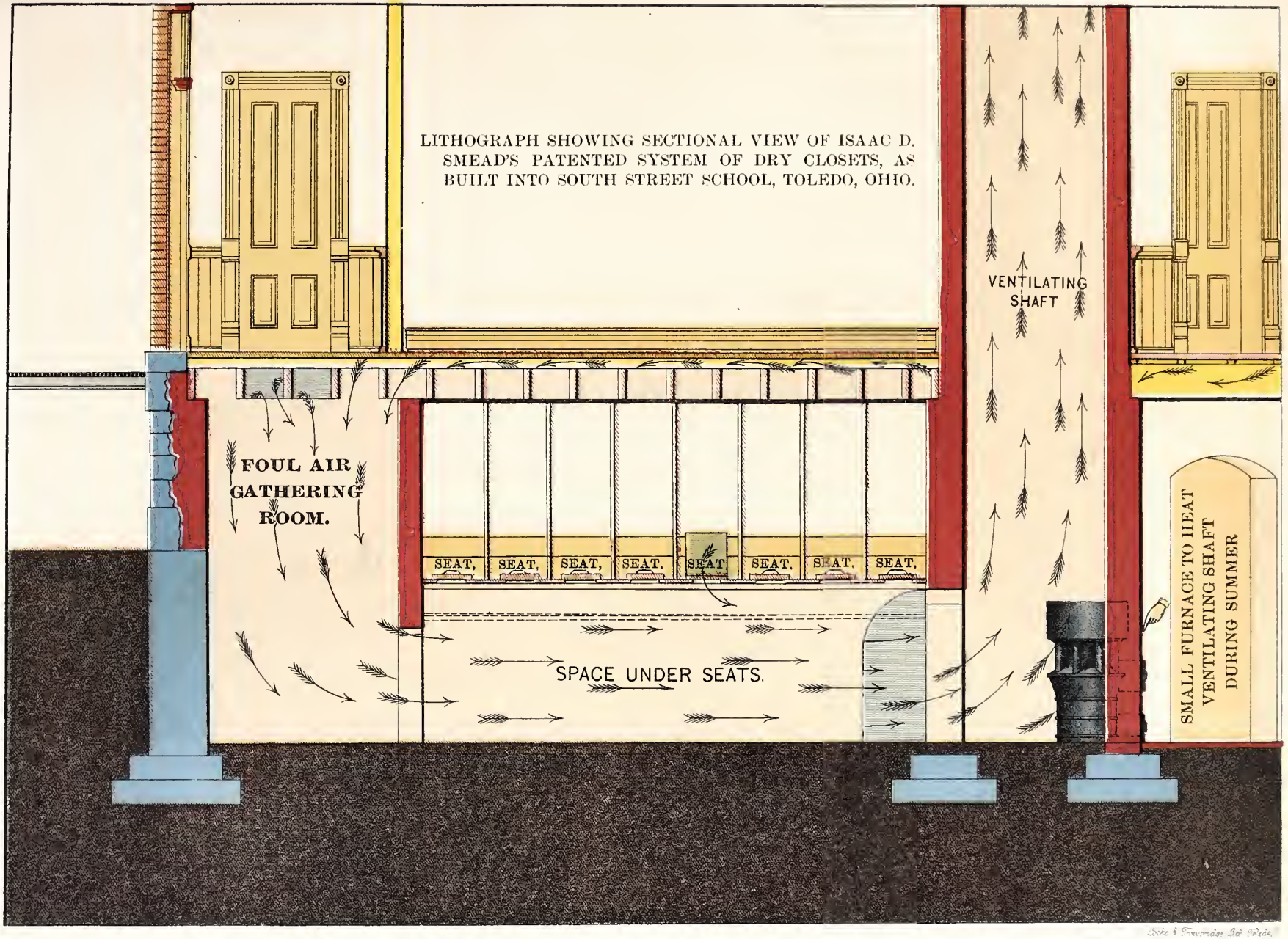
PLAN OF SECOND FLOOR SOUTH STREET SCHOOL BUILDING, TOLEDO, O.

For explanation see pages 23 and 24.

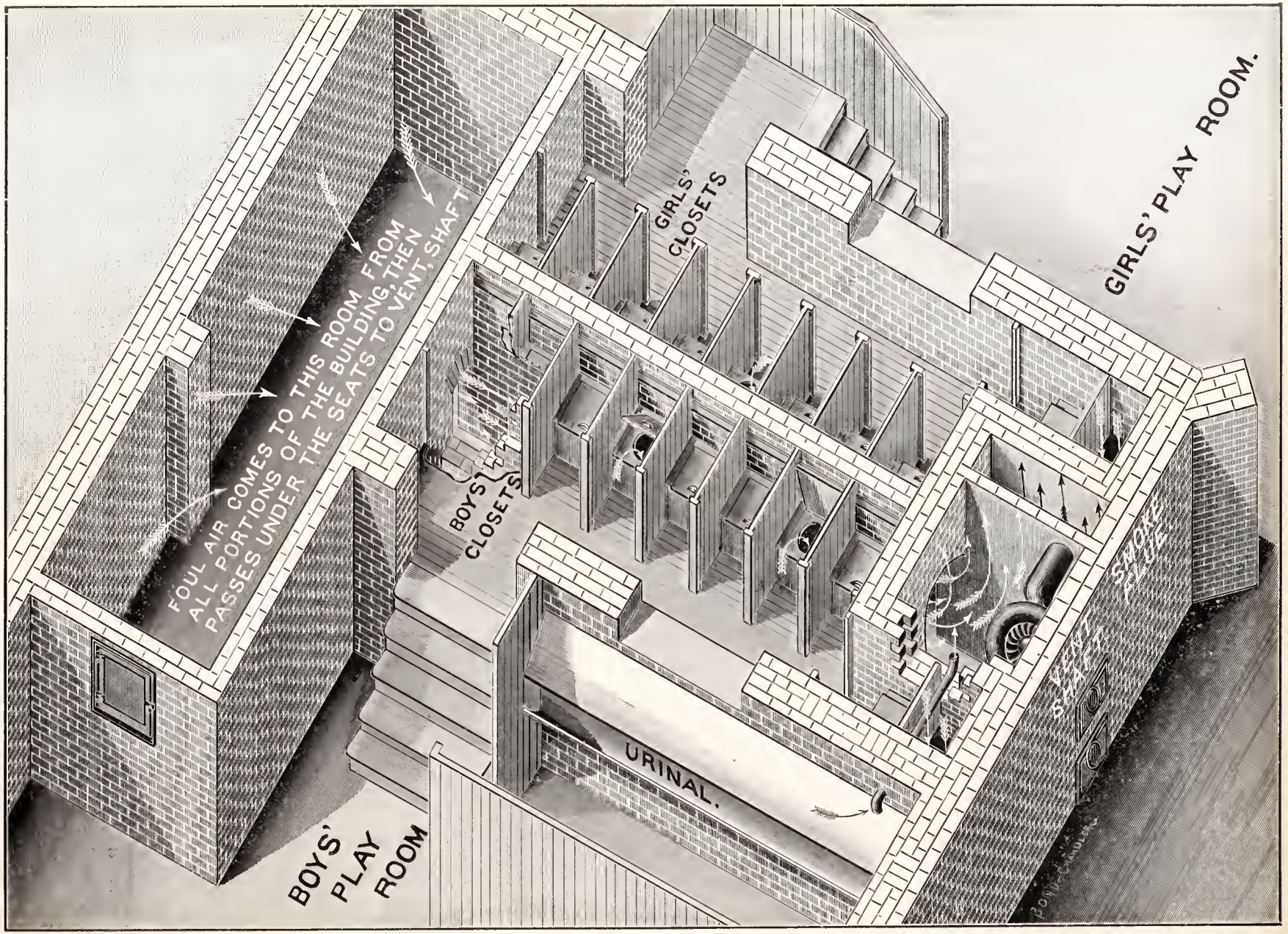


Perspective, showing a portion of first story in vicinity of ventilating shaft, South Street School Building, Toledo, Ohio. Representing ventilating shaft, smoke flue, two warm air flues, partition down which the air comes from second story, and also passage of air under the floors of school rooms to foul air rooms in basement, which is located directly under small corridor at rear entrance of building. (See page 72.)

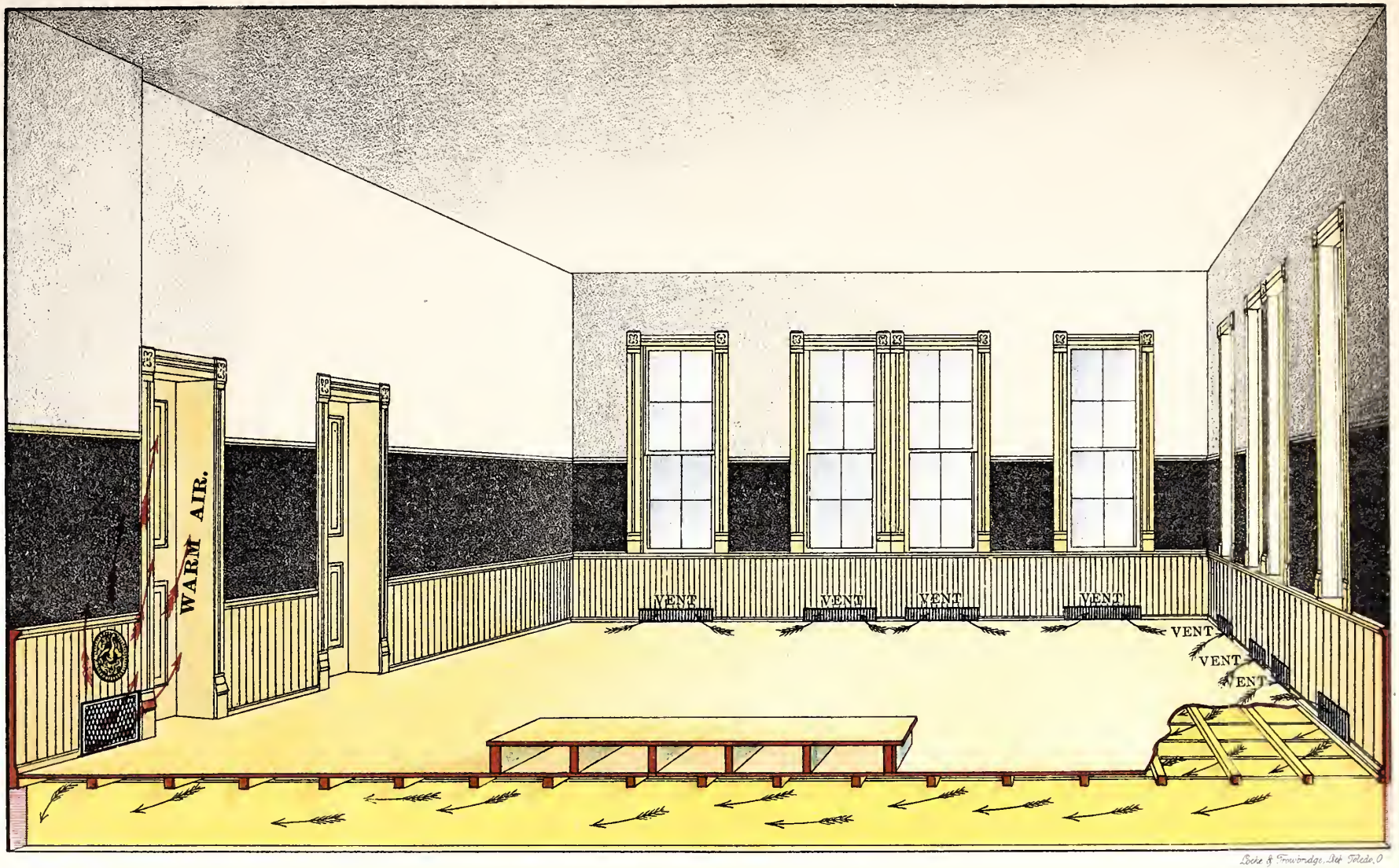
Isaac D. Smead's System of Dry Closets are located directly under the wardrobes. (See page 22.)



SECTION, LINE C. C. SHOWING DRY CLOSETS IN SOUTH STREET SCHOOL BUILDING, TOLEDO, O.

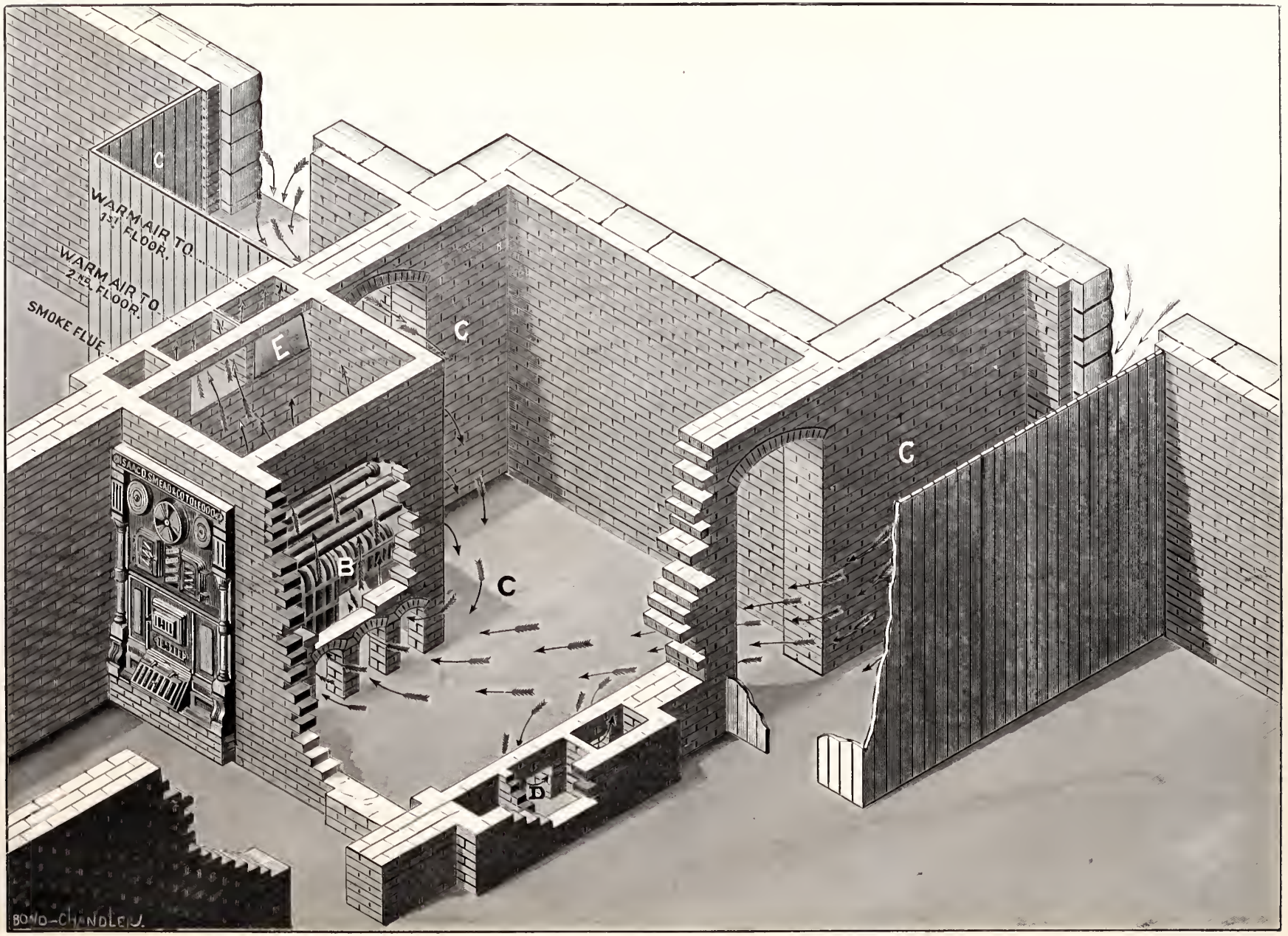


Isometric drawing representing ISAAC D. SMEAD'S SYSTEM OF DRY CLOSETS as applied to South Street School Building, Toledo, Ohio. For full description see pages 24, 25 and 26. (The drawing is not entirely satisfactory, but by careful examination of cuts on other pages, probably the reader will understand it.—I. D. S.)



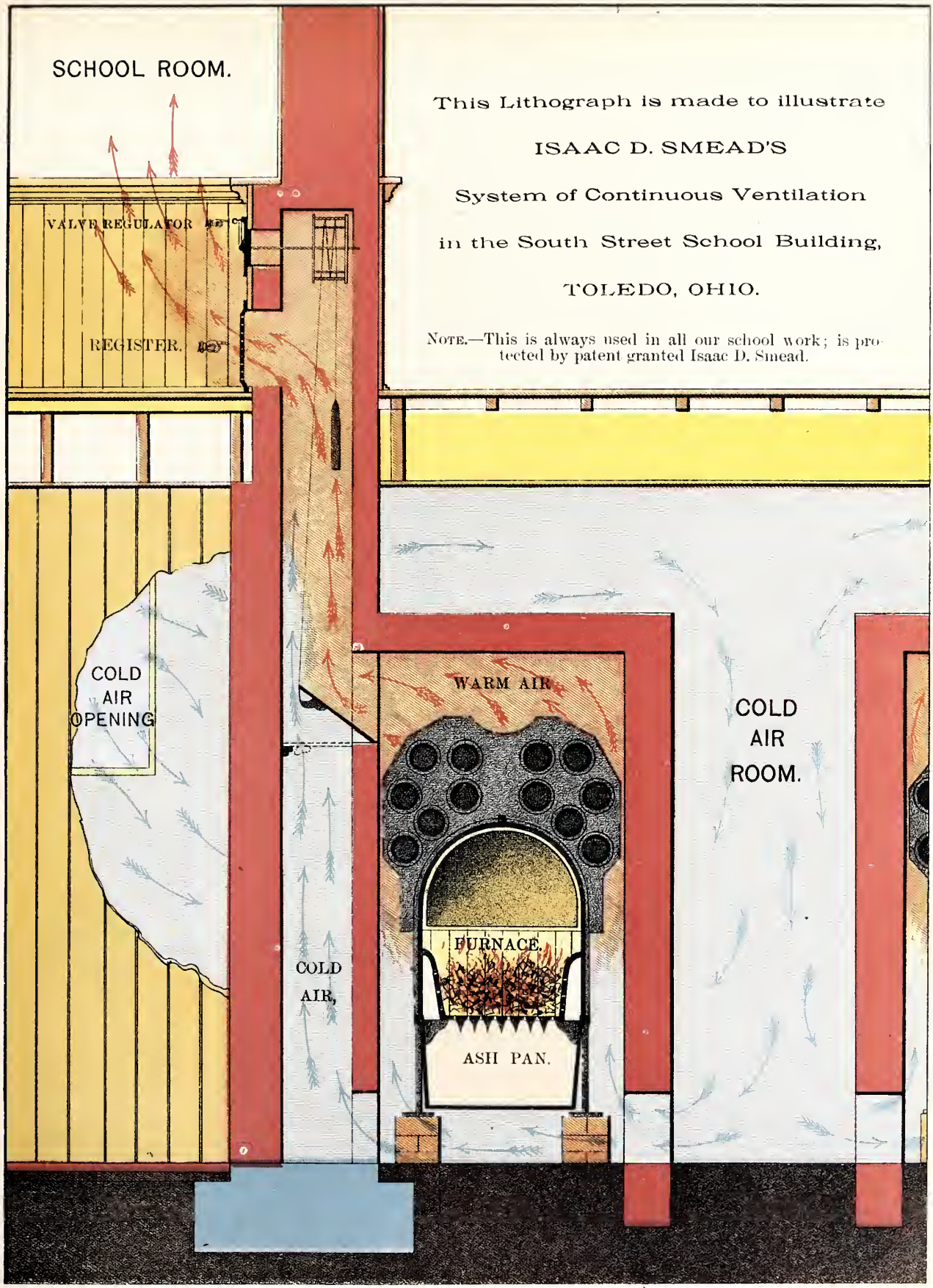
PERSPECTIVE VIEW OF ONE SCHOOL ROOM IN SOUTH STREET SCHOOL BUILDING, TOLEDO, O.
SHOWING WARM AIR REGISTER, VALVE REGULATOR, FOUL AIR EXITS,
FLOOR JOISTS, AND FURRING STRIPS.

NOTE.—This system of floor warming cannot be successfully used except in connection with patents owned by us. I. D. S. & Co.



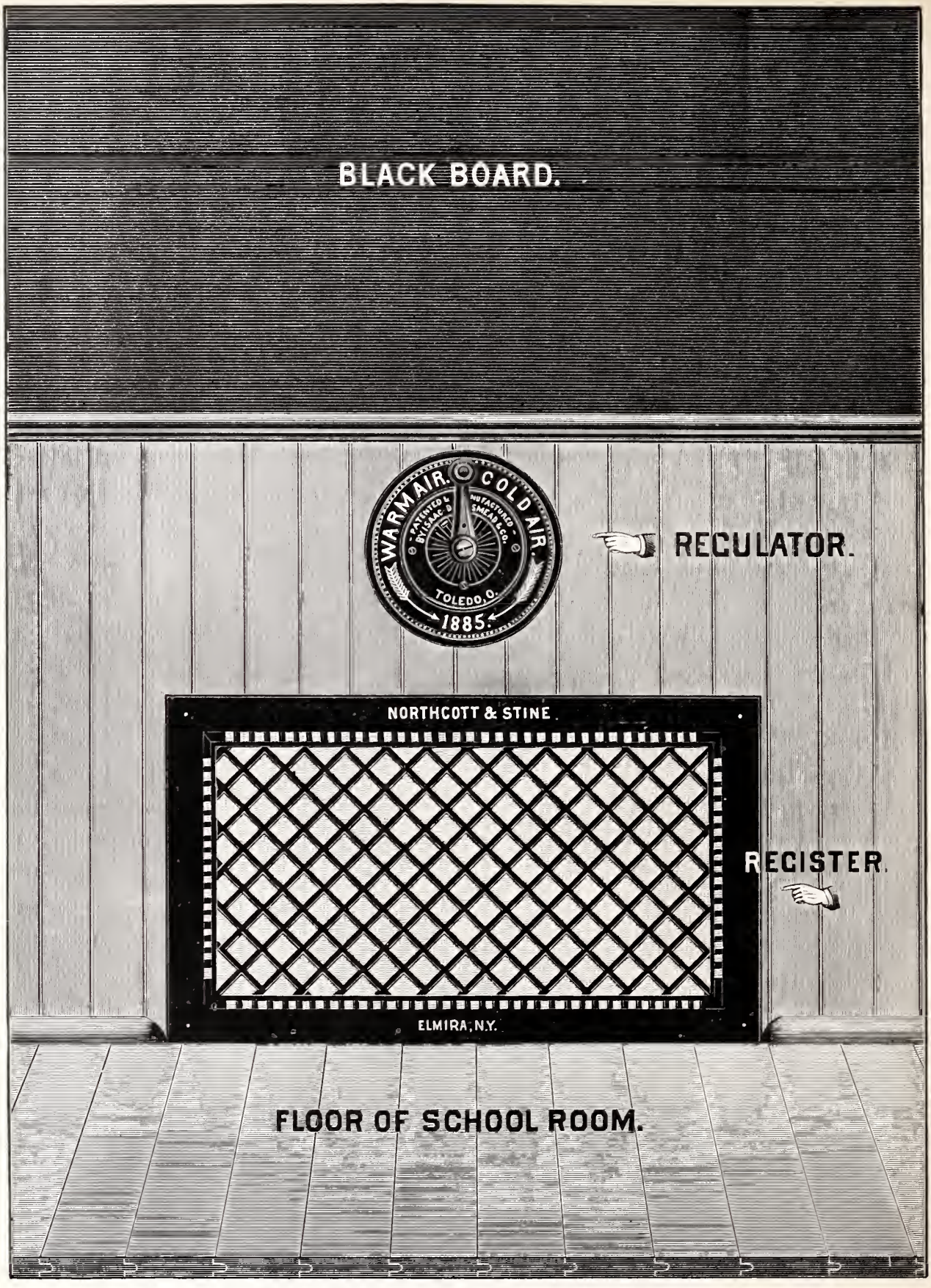
Isometric Drawing, representing one of the furnaces, cold air room and warm air flues, in the South Street School Building, Toledo, Ohio.

B. Air Warmer (furnace). C. Cold Air room. D. Entrance of cold air to Warm Air Flue. E. Valve to control supply of warm and cold air. With valve E closed as shown, cold air will go to room through the opening at bottom of flue as shown at "D." See article on page 21, referring to Smead's System of "continuous ventilation."



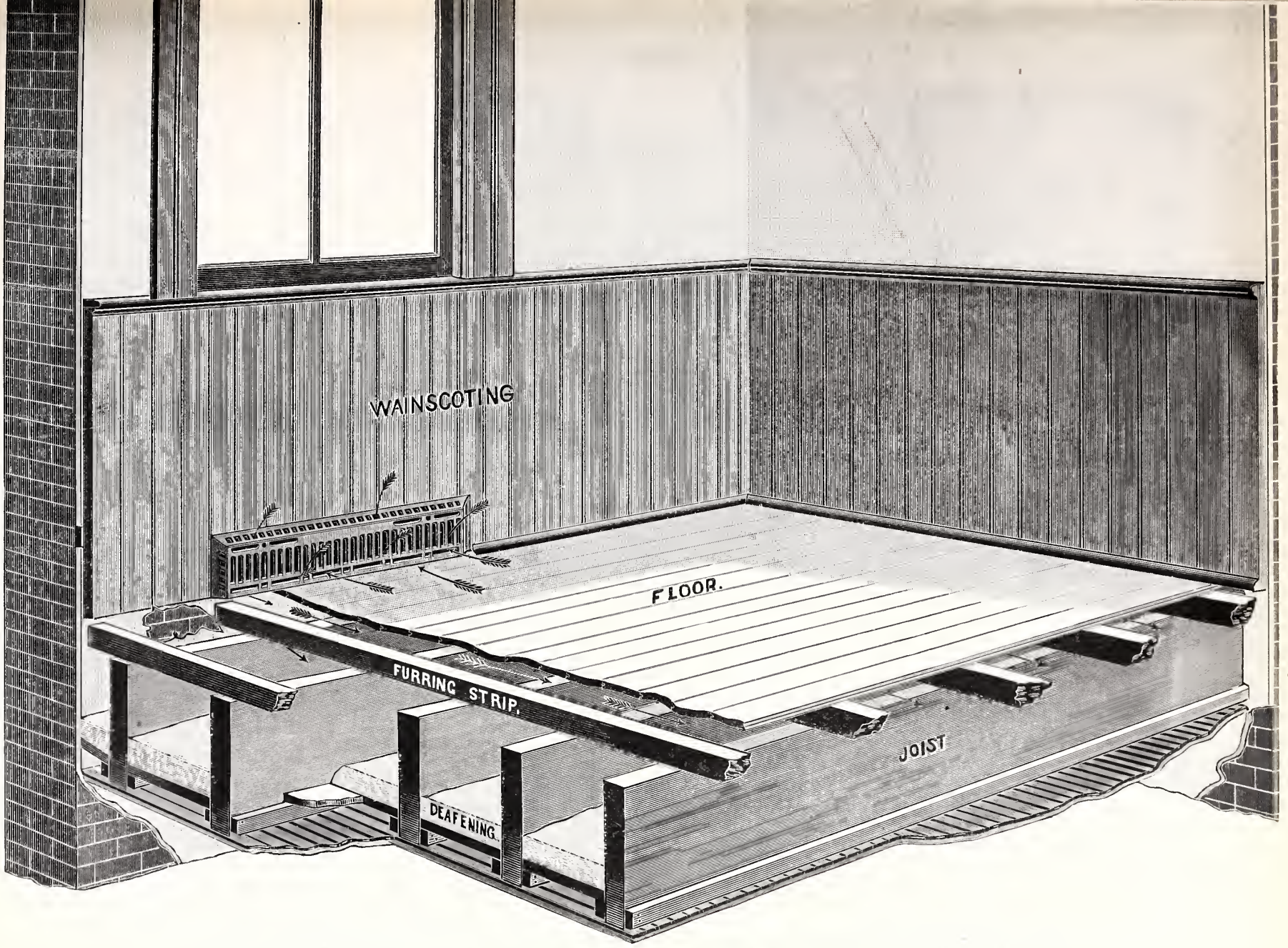
SECTION, LINE B. B. SHOWING COLD AIR ROOM, FURNACE, AND WARM AIR FLUE.

(South Street School Building, Toledo, Ohio. Also in fifteen other school buildings, Toledo.)



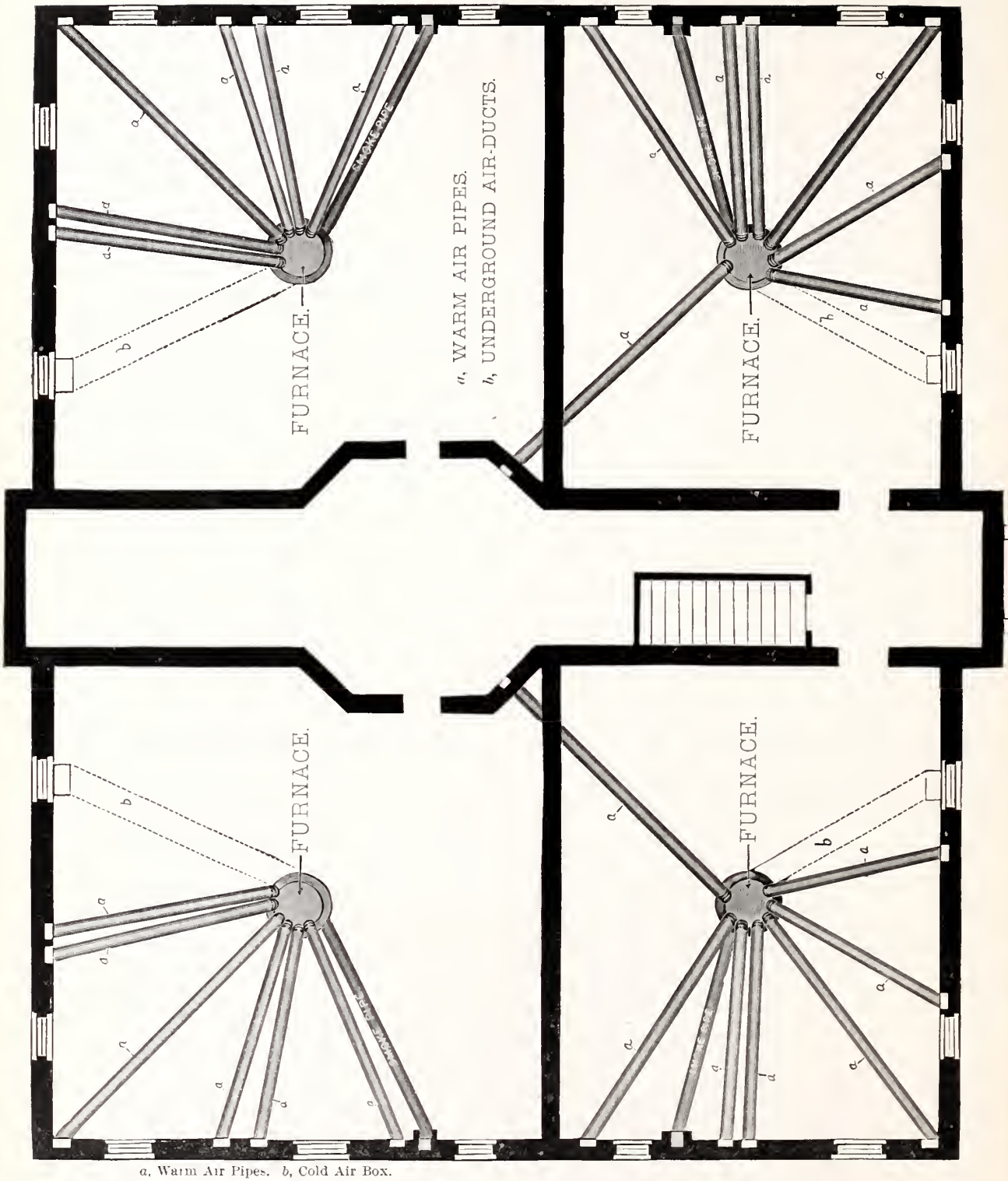
VIEW OF REGISTER AND REGULATOR.

(See page 21.)



VIEW REPRESENTING THE RUTTAN-SMEAD SYSTEM OF FLOOR CONSTRUCTION.

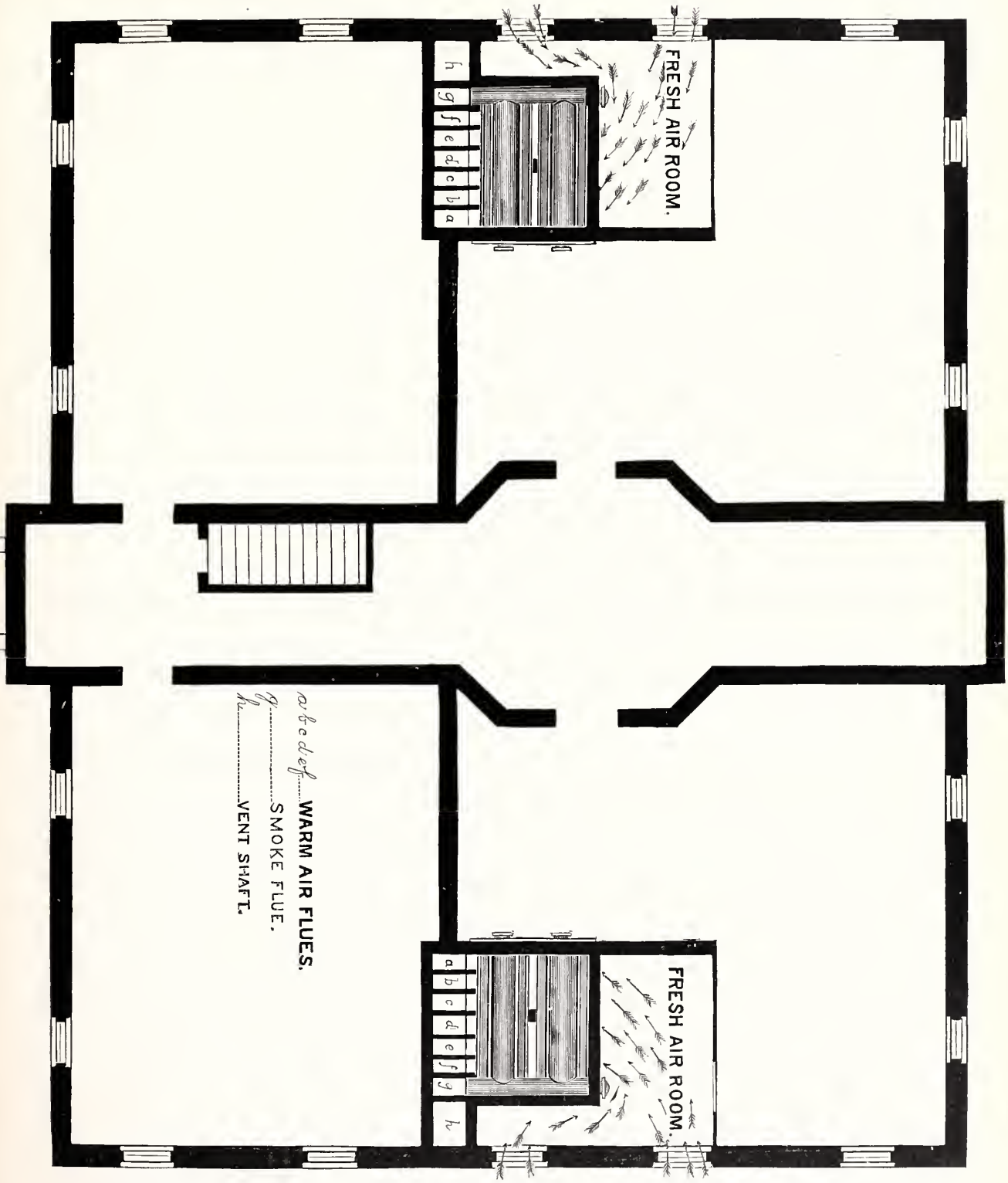
This is the plan referred to in lithograph G, page 34. This system of floor construction is protected by a patent owned by the five companies in whose interest this book is published.



a, Warm Air Pipes. *b*, Cold Air Box.

BASEMENT PLAN SCHOOL BUILDING, YOUNGSTOWN, OHIO.

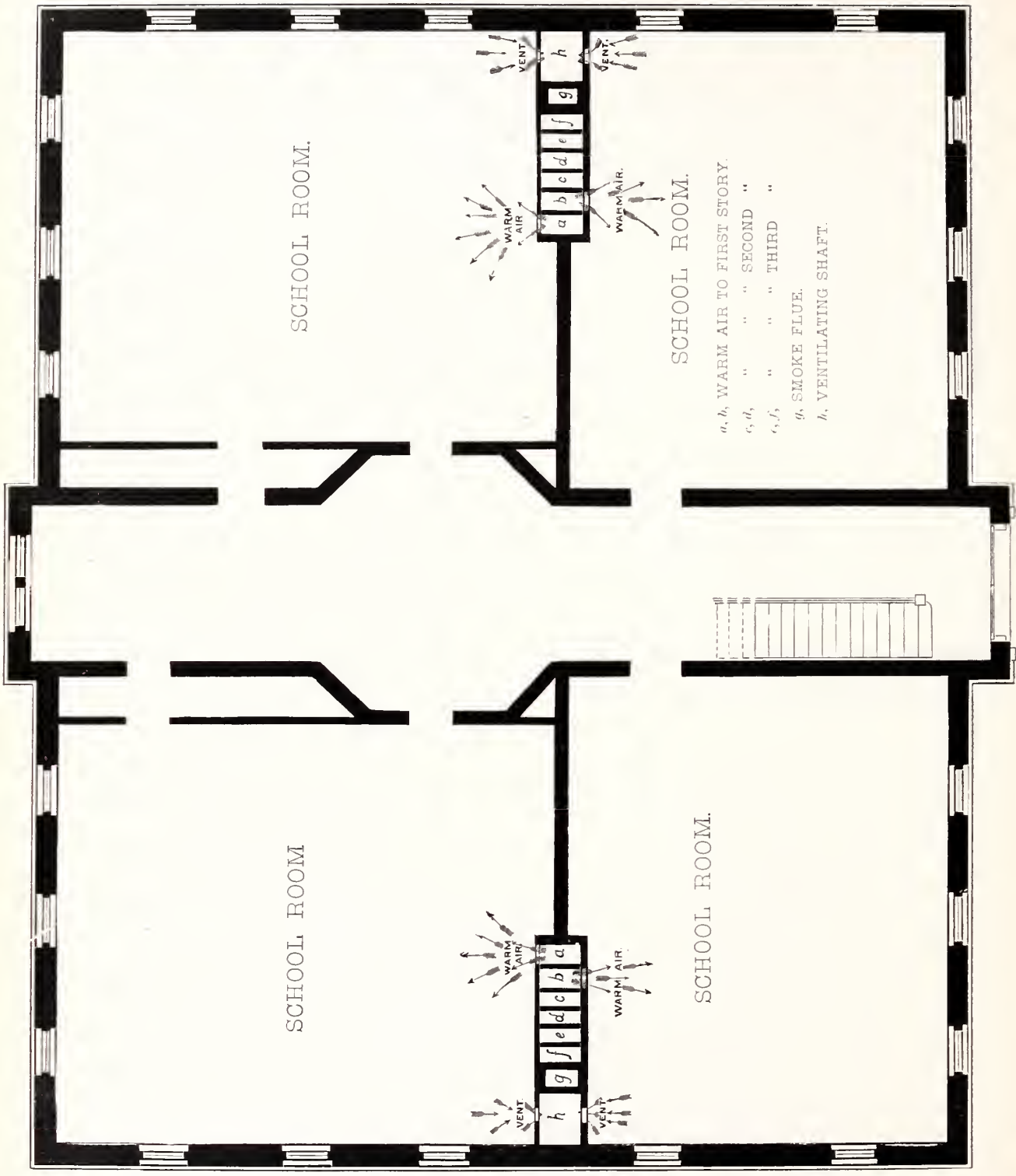
Showing application "Hot Air" System of Warming. For explanation see pages 18, 79 and 80.



BASEMENT PLAN OF SCHOOL BUILDING, YOUNGSTOWN, OHIO.

Showing application of Ruttan-Smead System of Warming.

See pages 18, 78, and 80.



PLAN OF FIRST STORY OF SCHOOL BUILDING, YOUNGSTOWN, OHIO.

See pages 18, 78 and 79.

Smead's School Room Heater.

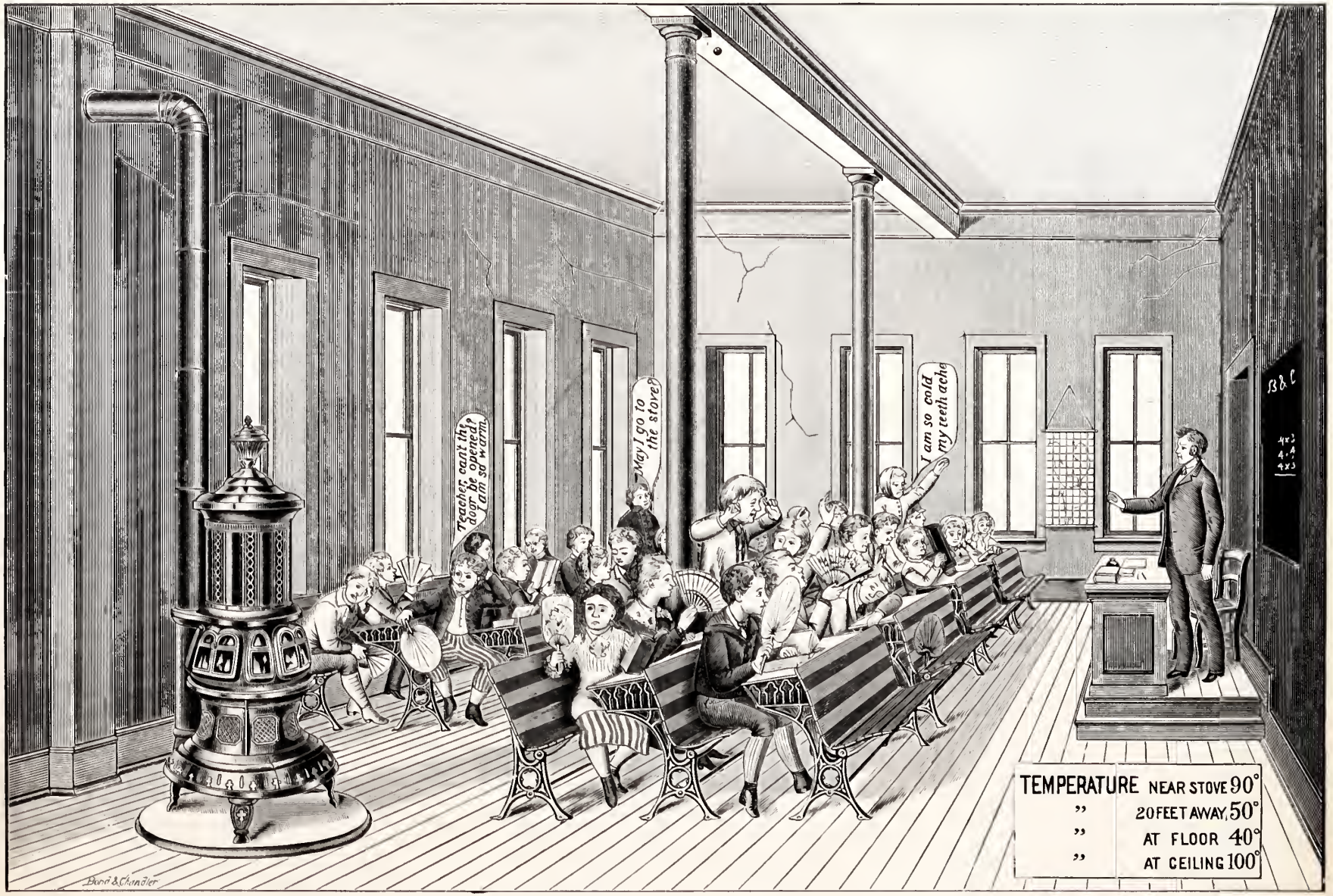
(See pages 82, 83, 84, 85 and 86.)

THE cuts on pages 83 and 84 represent the Ventilating Heater we are now manufacturing for use in school or other buildings where a furnace cannot well be introduced. The favor with which our *School Room Heater* has been received by school directors, church trustees, merchants and others, has induced us to expend a large sum in adding new features which, we think, will make it by far the most popular ventilating stove ever manufactured. The advantages of an OPEN FIRE over a CLOSED ONE, in the matter of *warming the feet* and conducting the foul gases from the room, are too apparent to require comment from us.

The first ventilating stove ever made was patented by Mr. Ruttan. For the past twenty years a great many of his stoves have been manufactured; but as they were only suitable for burning *wood*, we could not meet the demand for a *coal burner*. We are aware that there are other ventilating stoves (so called) in the West, and have examined them all with great care. We made the examination with the intention of buying the right to manufacture the one best suited to the work—that is, warming with a volume of air instead of by radiation. By our examination we learned that all schoolroom stoves were but little more than a common cannon stove with a sheet-iron case, and that the amount of air they would warm was by far too small to *properly* ventilate a schoolroom.

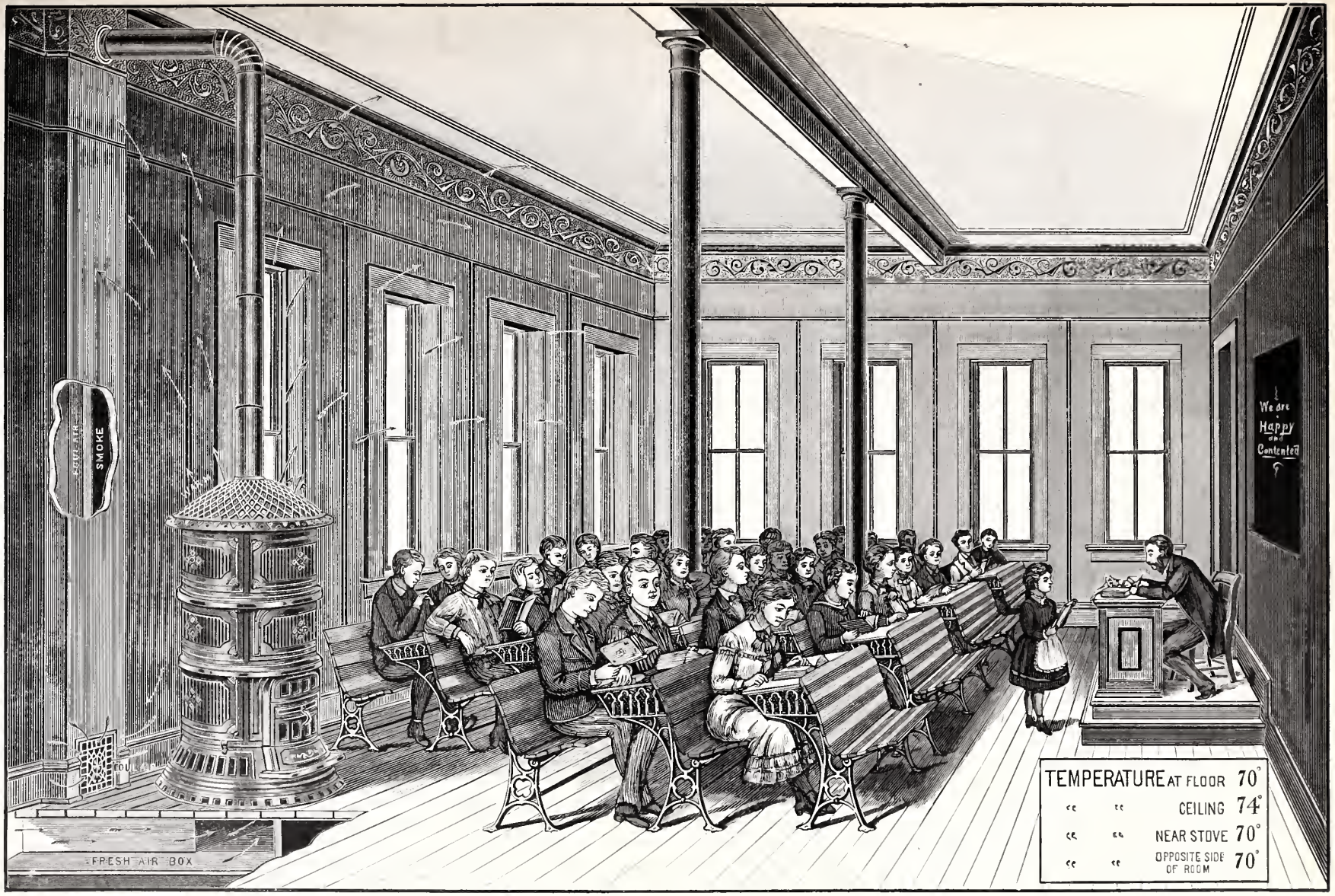
The principles upon which we have constructed our stove are substantially the same as we have heretofore used in our furnace, towit: a large amount of actual fire surface, large fire-box, and more than twice the grate surface of any other heater. The casing being of cast-iron radiates less heat, is more ornamental, and less liable to injury by *rust* or blows from pupils than if made of sheet-iron.

We guarantee the Heater to burn soft coal or wood equally well, although it is made with especial reference to the consumption of soft coal. Its weight is about *four times as much as other stoves*, and great care has been used to make it *durable*.



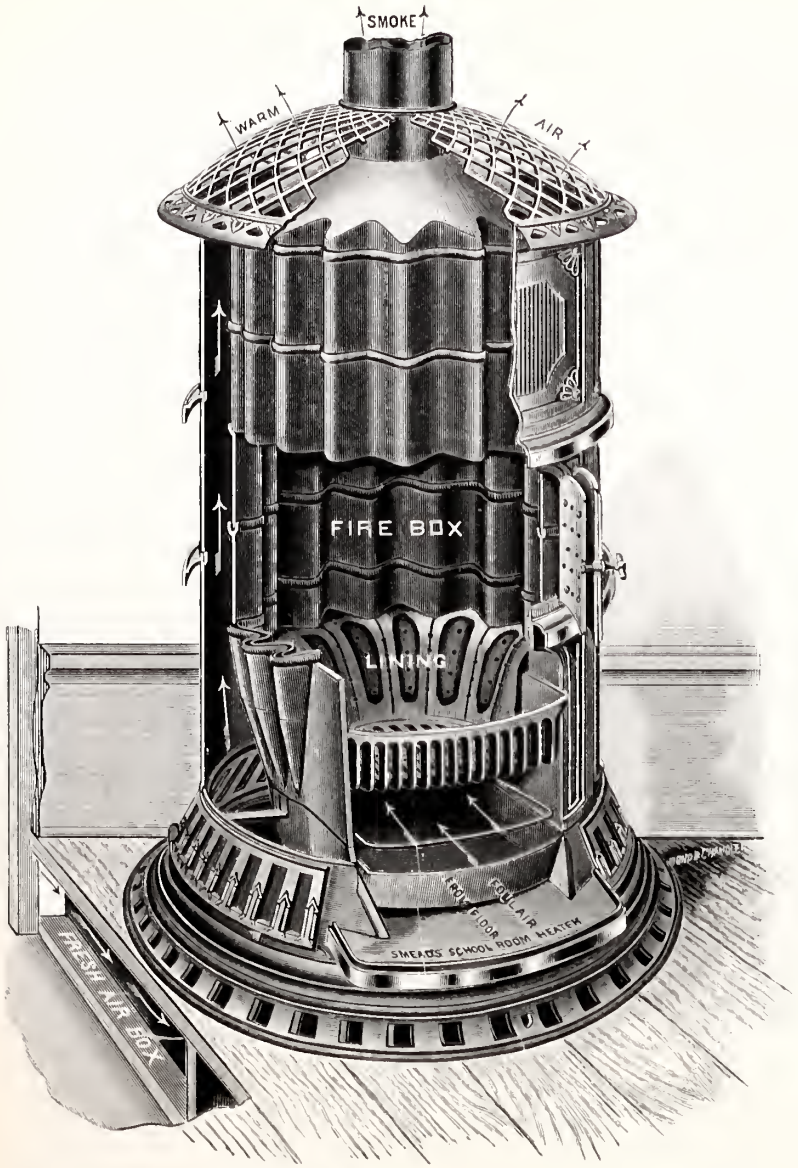
DIRECT RADIATION.

A possible condition of a School Room warmed (in part) with a common radiating stove. If the pupils were permitted to "speak their mind," the above would very truly represent the scene. See report of W. S. Frazier, page 121.



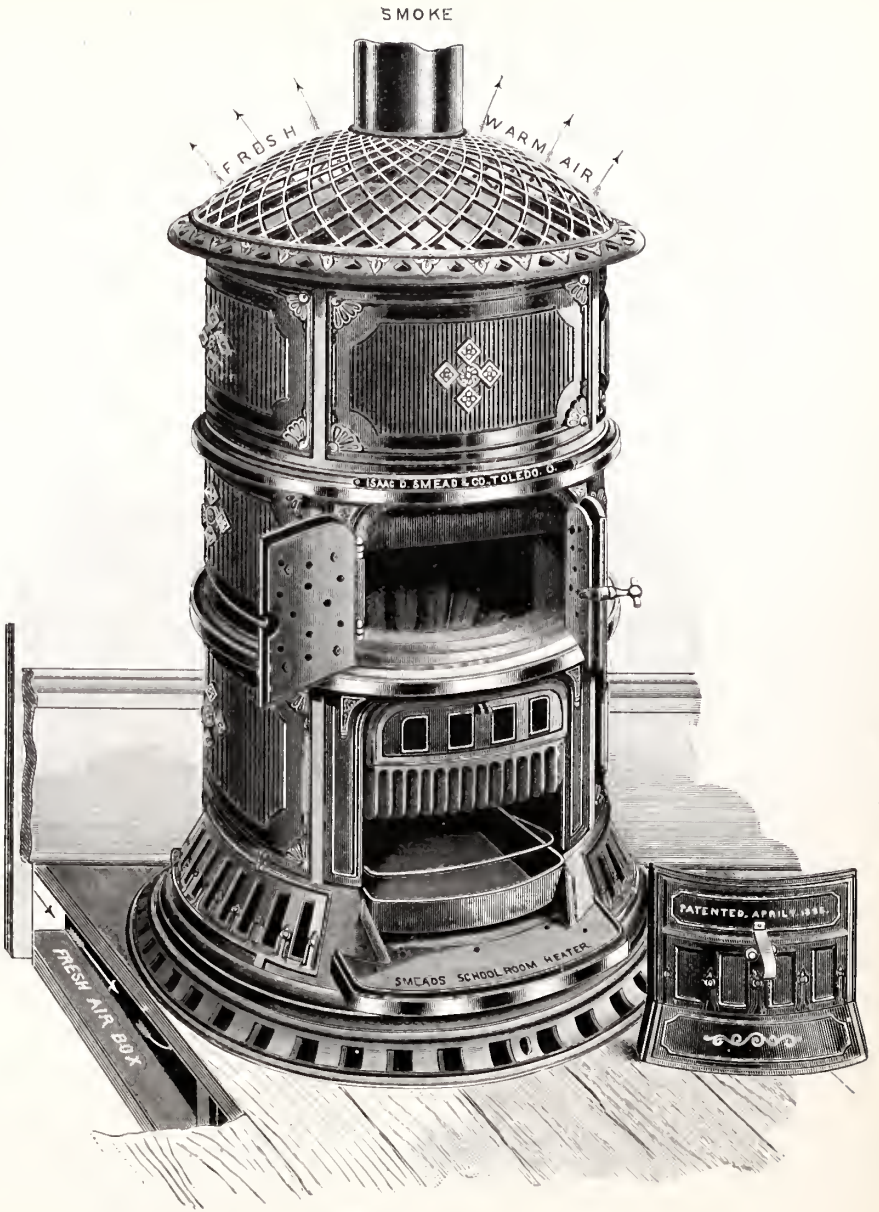
WARMING BY PURE AIR.

The condition of a School Room with Smead's School-Room Heater. (See page 81.)



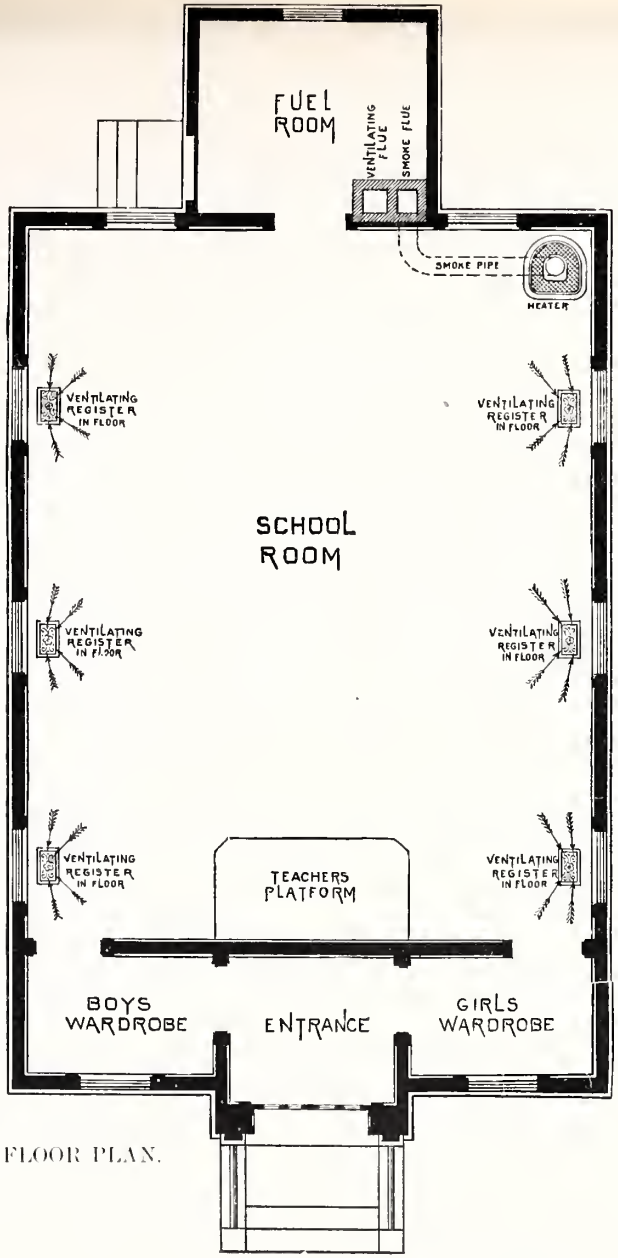
INTERIOR VIEW SMEAD'S SCHOOL-ROOM HEATER.

For description, see page 81.

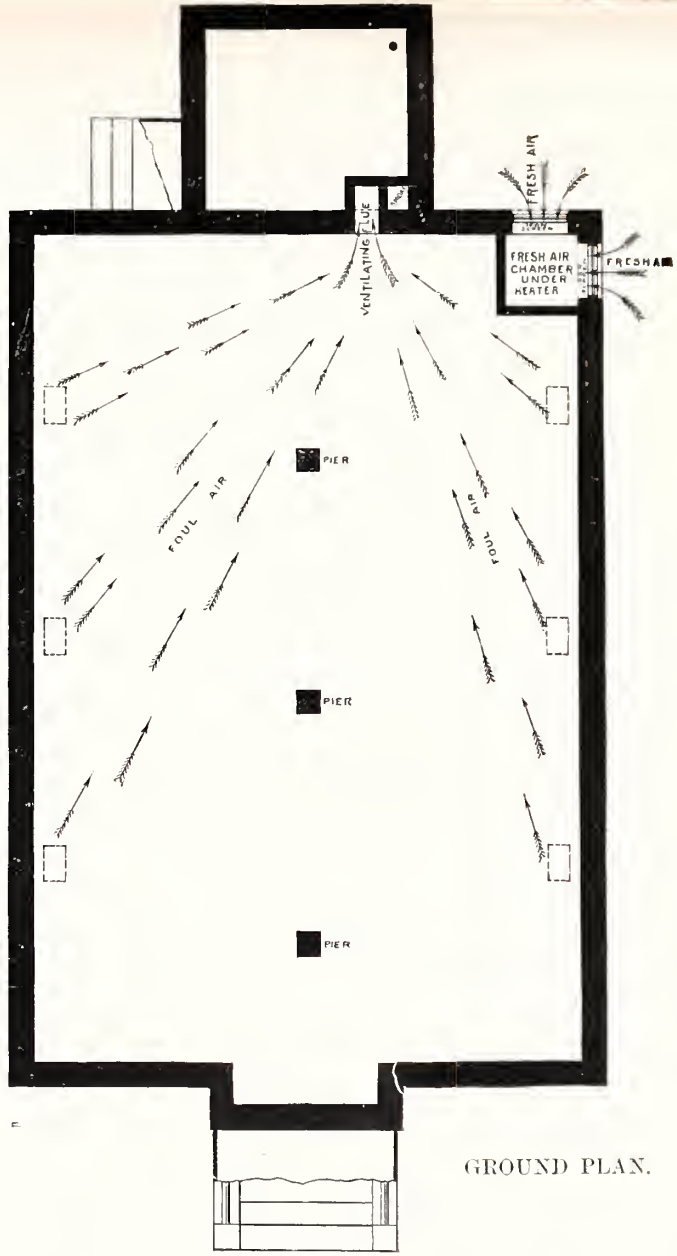


EXTERIOR VIEW SMEAD'S SCHOOL-ROOM HEATER.

For description, see page 81.



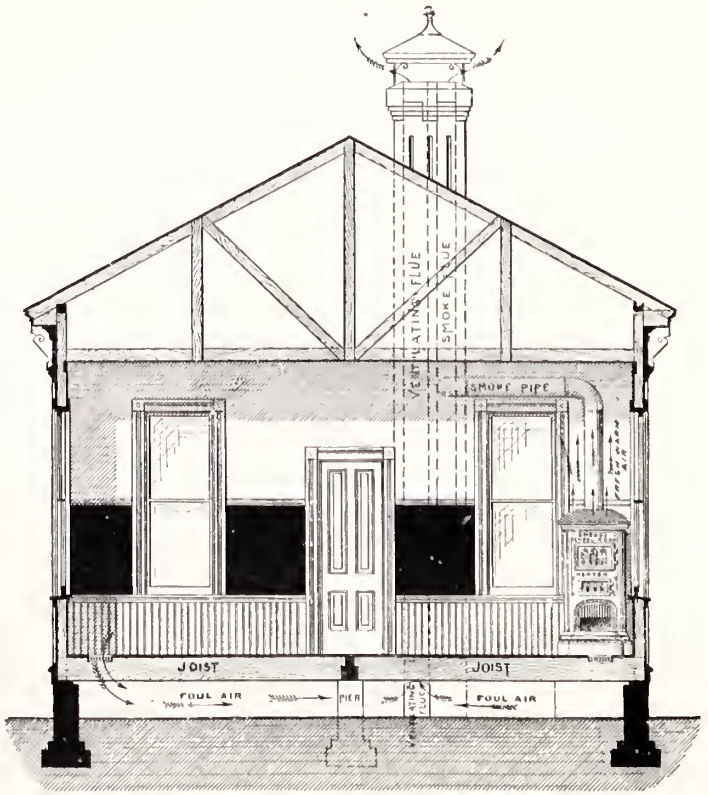
FLOOR PLAN.



GROUND PLAN.

FLOOR AND GROUND PLANS OF THE MODEL DISTRICT SCHOOL.

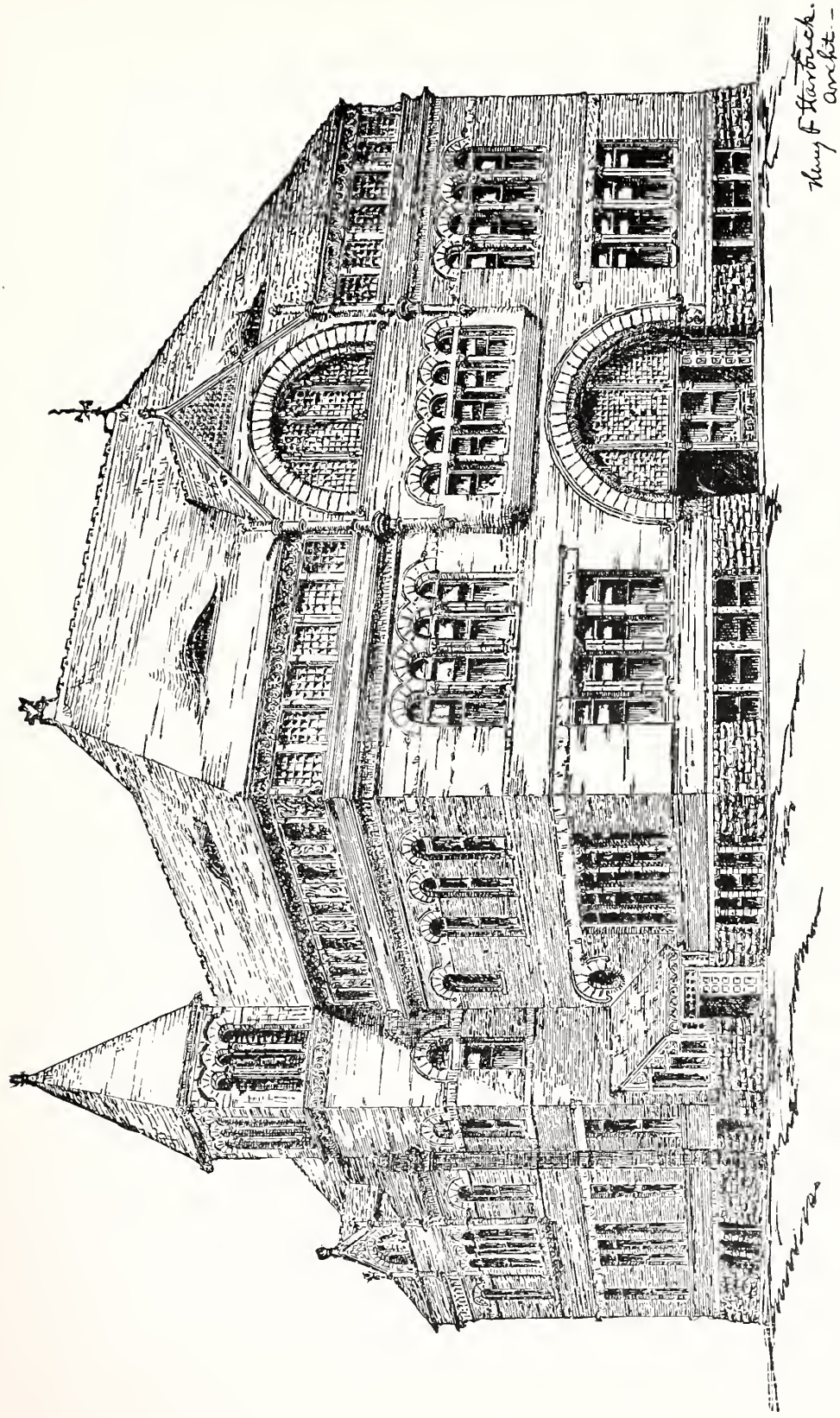
(See page 86.)



SECTION

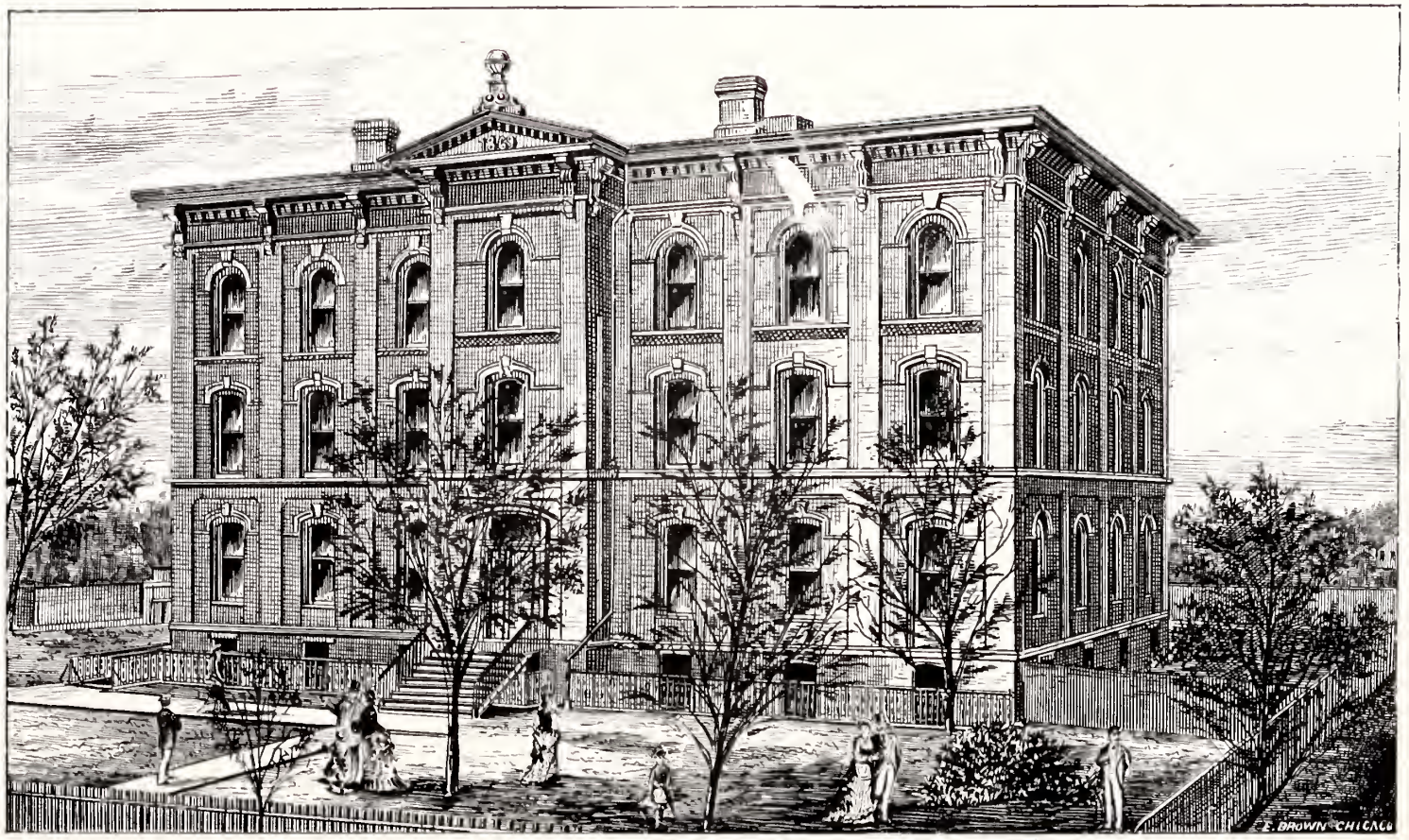
THE MODEL DISTRICT SCHOOL.

The Model District and Ward School Building—Warmed and Ventilated by Smead's School-room Heater.—Considerable sums are expended in arranging to warm and ventilate large school buildings, while the district school and ward buildings are always warmed with a common stove, and generally a *second-hand* one from some larger building, and no attention whatever paid to the important question of ventilation. Holes are left in the foundation walls through which the air can pass to prevent decay of joists and sills. This, of course, renders the temperature of space under the floor same as temperature outside (anywhere from 0 to 30° below), and the pupils sit all day with a board one inch in thickness between their feet and this sea of cold air, while their heads and bodies are in a temperature of from 40° to 90°, according to distance of seat from the stove, and this, too, in air which may have been breathed a dozen times. Who can wonder that they have cold feet, and are sometimes restless and unwilling to study, and that many are sick and unable to attend school more than one-half or two-thirds of the time? The plan of warming and ventilating buildings of this class represented above cannot but commend itself to all who will for a moment consider the two conditions. An entire change of air in the building every thirty minutes, temperature the same in all parts of the room, warm instead of cold air under the floor, should certainly be worth all it costs. For price of Heater and Registers, and other information on the subject, address NORTHCOTT & STINE, ELMIRA, N. Y.



PUBLIC SCHOOL BUILDING, HYDE PARK, ILL.

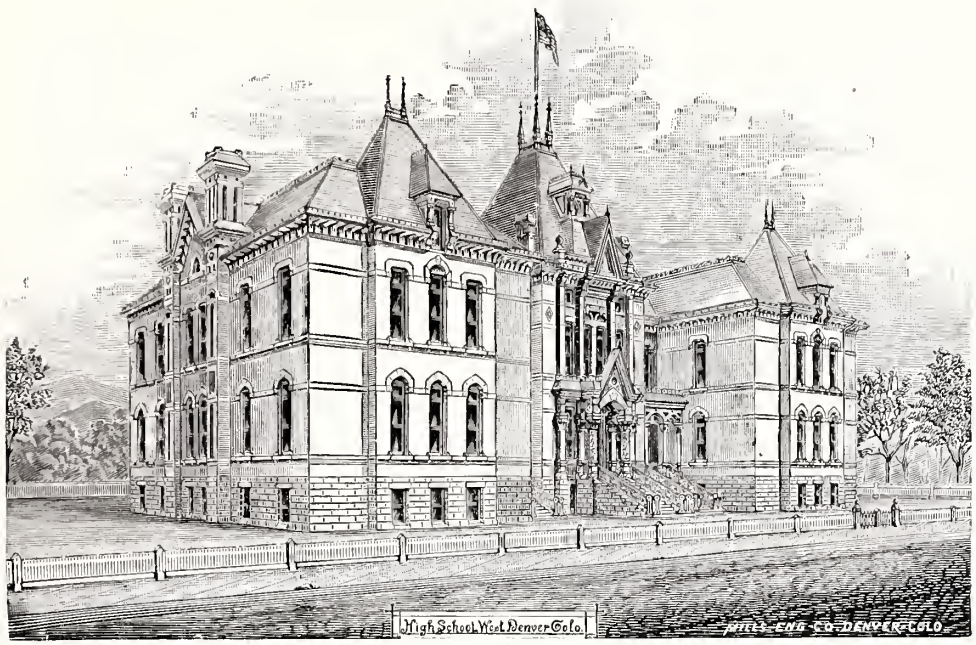
Warmed and Ventilated by Ruttan-Smead System.



HUMBOLDT SCHOOL BUILDING, TOLEDO, OHIO.

There are sixteen school buildings in Toledo (of which the above is a duplicate of eight) warmed and ventilated with the Ruttan-Smead Apparatus.

(See pages 50 and 54.)



HIGH SCHOOL BUILDING, WEST DENVER, COLORADO.

OFFICE OF THE BOARD OF EDUCATION, DISTRICT NO. 2.
DENVER, COLORADO, April 26, 1884.

LOUIS ROCHAT, Atchison, Kansas:

Dear Sir,—In reply to yours of the 14th inst., I would say that we have in our city six school buildings heated by the Ruttan System, four that are heated by steam, and several by the hot air system, and we consider the Ruttan System of heating and ventilating superior to all of them, both in economy and results.

The Central School is a six-room building, erected in 1880, and heated by two Ruttan Furnaces, which cost us $1,350; whereas the lowest bid we were able to get to heat it by steam was $1,850. The cost of repairs on these to date (three years) is $17.00. * * * * The amount of coal charged to this building last year was $278.25.

The Ebert School is an eight-room building, erected in 1880, and is heated by steam. The expense for repairs alone on the apparatus last year was $118 50. The amount of coal charged to the Ebert for the last year was $531.90.

The Franklin School * * * contains thirteen school rooms, Superintendent's office, two wardrobes to each room, a Director's office and two very large halls * * is heated by four Ruttan Furnaces and has been in use one winter—no expense for repairs. The amount of coal charged to this building for the year is $510.00. An exact record was kept for the month of January last, and the building was warmed twenty-six days and consumed nineteen tons of soft coal.

The Gilpin School is a twelve-room building and is heated by steam; was built about two years ago. The expense for repairs on heating apparatus last year was $148.00 and the amount of coal charged to it was $744.25.

The Longfellow School is an eight-room building, heated by the hot air system. It cost for fuel last year $494.39.

The Fairmount School is a six-room building, heated by the Ruttan System for two winters, and no expense for repairs. It cost us for fuel last winter $220.50.

The other three buildings heated by the Ruttan System have been in use one and two winters with no expense for repairs, and the amount of fuel used is substantially the same as those given. I think the record of the buildings mentioned sufficient to establish the fact that the Ruttan System is the most economical in three things: first cost, fuel, and repairs, besides having the advantage of giving *better results in ventilation*. We have two men on our board who are practical steam men, and thoroughly understand the steam system, and they are opposed to the use of steam where heat and ventilation only are required. * * * They are at the head of the Denver & Rio Grand shops * * * and are perfectly aware of the petty annoyances of burnt crownsheets, leaking flues, sediment deposits, condensation of steam in pipes, freeze-ups, bursting pipes, leaking joints, etc., etc., to say nothing of its first cost. In conclusion, let me say that there comes a time in the history of every boiler when it must come out either for repairs or to be replaced by a new one, either of which is very expensive, while everything connected with the Ruttan System that is liable to wear out can be replaced at small cost and without detriment to the building or furnaces.

Please excuse delay, as I wished to examine the books before answering, so as to give exact figures.

We pay five dollars and twenty-five cents ($5.25) per ton for soft coal.

Respectfully yours,

A. D. SHEPARD, *President of the Board.*

RUSH MEDICAL COLLEGE, CHICAGO.

We refer by permission to Norman Bridge, M. D., for many years Professor of Hygiene and Adjunct Professor of the Principles and Practices of Medicine in Rush Medical College, and Ex-President of Chicago Board of Education.

The size of the building is 62 by 80 feet, independent of projections on the sides and in front, of four and three feet respectively. The height is 80 feet.

On the floor above is the lower or chemical lecture-room, 38 by 69 feet, and 18 feet high.

On the third floor is the upper lecture-room, the amphitheater, 49 by 69 feet, and 36 feet high, reaching into the mansard roof, and lighted in part by a skylight 16 by 20 feet. In the rear of this room is the museum, 35 by 48 feet and 19 feet high; while under the seats of the amphitheater are eight rooms used for the accommodation of different professors, and for various other purposes of the college. The seats of both rooms are arranged on the amphitheater plan. The upper lecture-room has 362 numbered seats; the lower 316. The seats are in the style of opera chairs, with iron frames and hardwood furnishing.

Over the museum is the dissecting-room, 25 by 64 feet and 19 feet high. This room is lighted by windows on three sides and by a skylight 7 by 16 feet; it is provided with an asphalt floor.

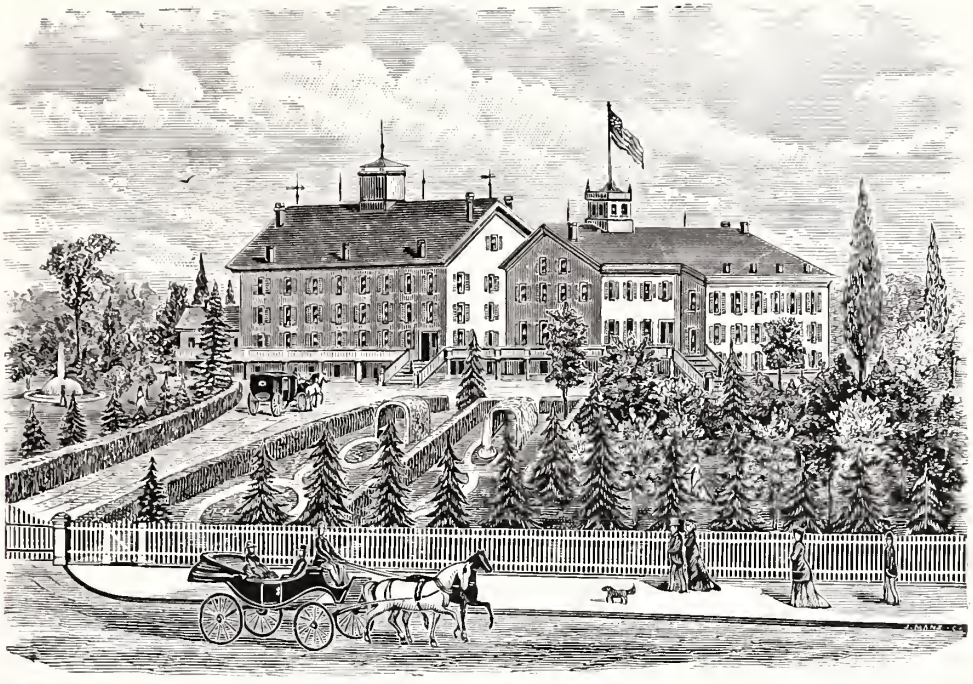
A very thorough investigation was made by building committee before contract for heating and ventilation was let, and the "Ruttan" was unanimously adopted.—*Annual Report.*

RUSH MEDICAL COLLEGE, Chicago.

J. E. SIMPSON, Decorah, Iowa:

Dear Sir,—Your letter of the 24th inst. came duly to hand. In reply to your interrogatories I would say *that we do get* the proper degree of heat and ventilation in the coldest weather from our heating and ventilating apparatus. I think the system is decidedly a *success*, and there is nothing in use in the way of heating apparatus for public buildings equal to the Ruttan System. Very truly yours,

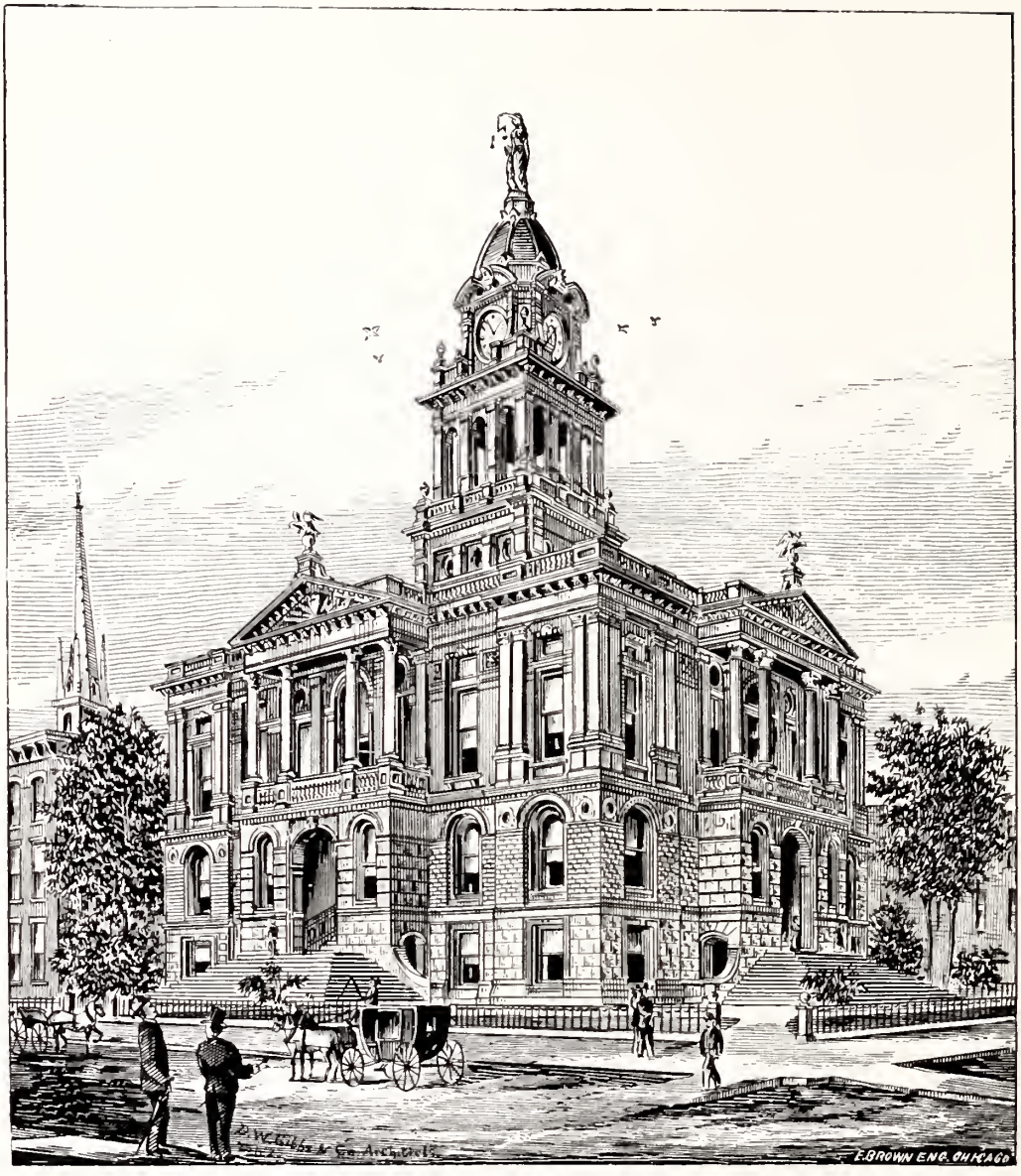
JOSEPH P. ROSS, M.D.



MOUNT CARROLL FEMALE SEMINARY, MOUNT CARROLL, ILL.

(See page 110.)

The new and a portion of the old buildings are heated by Ruttan Furnaces and ventilated by the Ruttan System. The admirable system of heating and ventilation here in use seems so nearly perfect as to remove all possible objections to warm-air furnaces. Four Ruttan Furnaces warm evenly some eighty rooms, of great variety of size, from the bath and private rooms, twelve by fourteen feet, up to the size of sitting-rooms, parlors, library, dining-room, the last being forty-four feet square; ceilings of height from nine to twelve feet. Each room has an independent flue of brick, conveying the heat direct from a sheet-iron reservoir, which is seventy feet long by six feet wide and two feet deep. This reservoir is supplied with pure air direct from the tubular furnaces. The construction of the furnaces is such that they are never heated to redness, hence the air is never "burned." The tubular arrangement applies the principle of the locomotive boiler, only that the furnace is surrounded by air instead of water. The great amount of heating surface thus exposed admits of a large volume of pure, cold air, which is not burned and deoxidized as in many furnaces, but warmed by a pleasant, healthful temperature. To perfect the warming of each room the system of ventilation used in connection with these furnaces, is the more important feature. A large chimney is located in the center of the building, a small part of which is used for the smoke from the furnaces, and thus the volume of air in the larger part is heated, adding to the draft. The air passes from the room through perforated iron base, under the floors and down the partitions to base of the exhausting or ventilating chimney; thus there is a constant draft upon all the air of the building, and the capacity of the box supplying fresh air, and the exhaust chimney, are such as to allow complete change of the air in the building every half hour. As we have said, every room is evenly warmed, the temperature at floor and ceiling varying only 1 to 4°, all the heat in the air passing from rooms to exhaust flue being utilized in warming the floors. A thermometer is furnished to every room, and the standard temperature is 70°. The same system is here applied to the ventilation of the "water-closets" (or more properly here, "dry-closets"), which are thereby kept from all offense, something rarely attained to in so large a household. On the whole, we are convinced, by the uniformly pleasant and healthful atmosphere we find pervading the seminary, that the method here in use cannot be excelled, and that to it some of the credit is due for the uniform good health among the members of the institution.—*Iowa Homestead.*



FAYETTE COUNTY (OHIO) COURT HOUSE.

D. W. GIBBS & CO., TOLEDO, OHIO, ARCHITECTS.

After a very thorough investigation of the various plans for warming and ventilating public buildings, the Commissioners made the following report. * * * The bid of Isaac D. Smead & Co. being the lowest, and their system being, in the opinion of the Commissioners, the best, the award is made to them. * * *

ROBT. S. SUTHERLAND,
W. J. HORNEY, R. S. EYRE, } *Commissioners of Fayette Co., O.*

JAMES P. ROBINSON, *Auditor.*

HIGH SCHOOL BUILDING, OTTAWA, KANSAS.

OFFICE OF BOARD OF EDUCATION, OTTAWA, Kan., January 30, 1885.

ROBERT ELLIOTT, Church Building Committee, Hannibal, Mo.:

Dear Sir,—I take pleasure in stating that we have used the Ruttan System of warming and ventilating in our high school building continually for *thirteen years.* This building is a large, three-story, twelve-room building. *We also introduced it last year in a sixteen-room building.* I can say that it has given us excellent satisfaction, and we are well pleased with it. Very respectfully yours,

A. DOBSON, *President Board of Education.*

DISTRICT SCHOOL BUILDING, RIVER FALLS, WISCONSIN.

RUTTAN MANUFACTURING CO., 68 Lake Street, Chicago: RIVER FALLS, Wis., March 27, 1885.

Gentlemen,—At the close of the hardest winter Wisconsin has known in twenty years, it gives me pleasure to testify that the Warming and Ventilating Apparatus which you placed in our main building has fully met the severe demand made upon it. With weeks of weather during which the *mercury constantly marked* 25 *to* 40° *below zero,* we have had no difficulty in maintaining our rooms at a temperature of 72° Fahrenheit, and securing a complete change of air every twenty-five minutes. I hope to see this system more thoroughly introduced in the new public buildings of our state. Very truly,

C. H. KEYES, *Principal of Schools.*

HIGH SCHOOL BUILDING, NORWALK, OHIO.

L. D. GROSVENOR, JACKSON, MICH., ARCHITECT.

(See Canton report, page —.)

REPORT OF COMMITTEE ON HEATING AND VENTILATION.

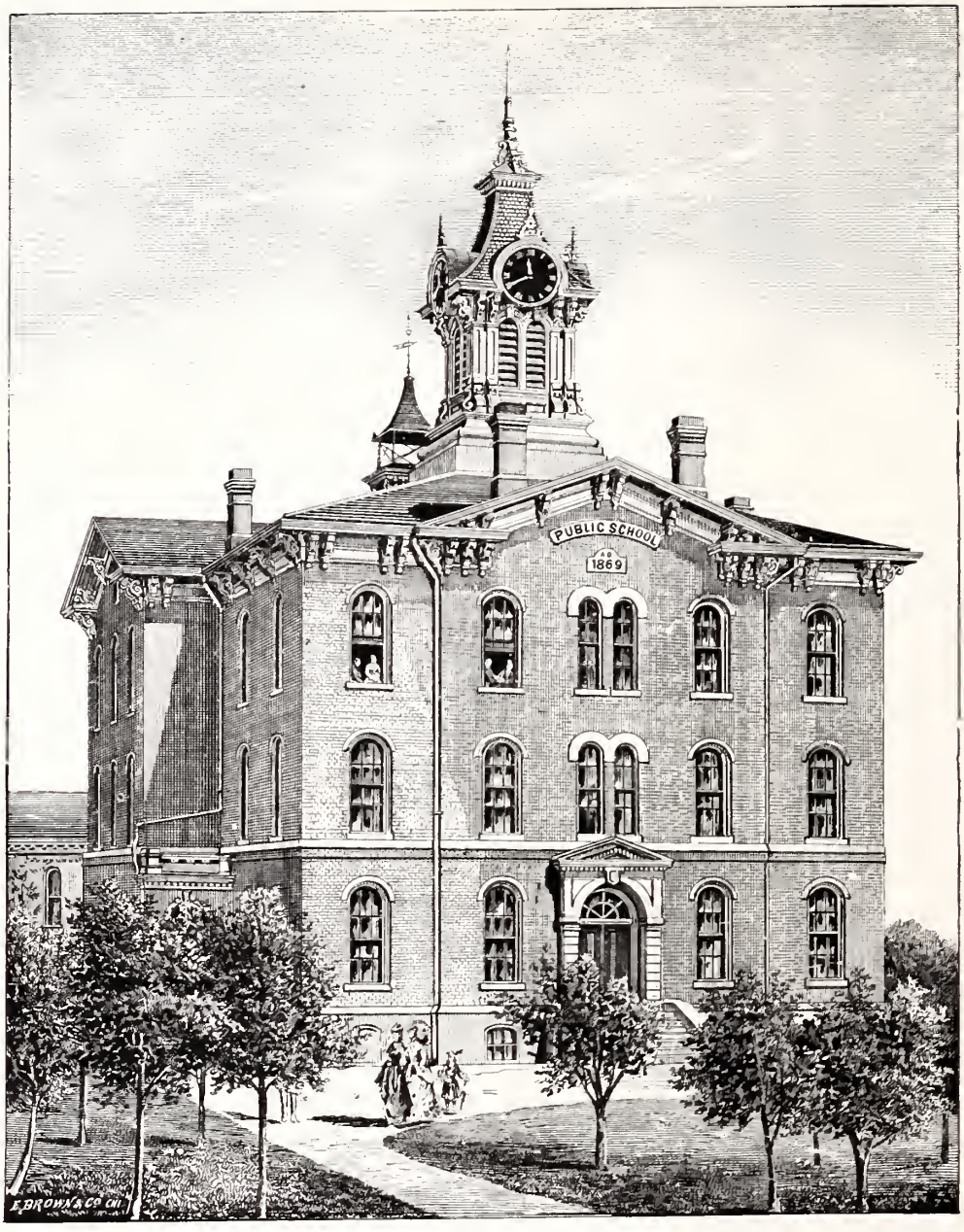
NORWALK, Ohio, June 14, 1883.

A Committee of the Board of Education, consisting of Mr. Boughton, Mr. Knapp, Mr. Parker, Doctor Hildereth and Mr. Williams, would report that they have jointly or severally examined the system of heating by steam and also by warm air, as used in the school building at Jackson, Mich., at Fostoria, at the new high school building in Cleveland, at Painesville, at Toledo, and at Defiance, for the purpose of determining upon the best system for heating and ventilating our new Central School house, and we think we may say that we have given to this subject much more thorough and careful investigation than is usually given to it in connection with public buildings, for we regard heating and ventilation as of paramount importance to the health and comfort of our scholars, *and the result of our investigation is that for combined heating and ventilation we find the system known as the Ruttan-Smead Warm Air Heating and Ventilating has proved the most efficient in practical use of any that we have found*, and we recommend its adoption in our new school building, and we would further recommend that the proposition of Isaac D. Smead & Co. (Ruttan Heating and Ventilating Company) to warm and ventilate our building in accordance with their contract which they propose for our acceptance, be accepted by the Board. We would further say that while we think it the best system, the cost of putting it in is but about one-half of steam heating, so far as we have investigated.

THEO. WILLIAMS,
E. G. BOUGHTON,
S. P. HILDERETH, } *Committee.*
GEO. W. PARKER,
GEO. W. KNAPP,

The President and Clerk of the Board were authorized and instructed to contract with the Ruttan Heating and Ventilating Company, in accordance with their proposition submitted.

May 1, 1885. Their experience has in every particular shown the wisdom of their action.



PUBLIC SCHOOL BUILDING AT ROCHELLE, SHELBYVILLE, TUSCOLA, ILL., AND MICHIGAN CITY, IND.

G. P. RANDALL, ARCHITECT.

ALL HEATED BY THE RUTTAN FURNACES. WARMED AND VENTILATED BY THE RUTTAN SYSTEM.

OFFICE FIRST NATIONAL BANK, ROCHELLE, ILL., August 4, 1876.

E. M. EVANS, Sec'y Board of Education, etc., Vinton, Iowa.

Dear Sir,—Yours of July 25 came to hand this morning. The Ruttan system of ventilation works to perfection with us. It keeps the rooms constantly full of fresh air, and the foul air passes out as fast as the fresh air comes in. The teachers do not complain of the dizziness they formerly did. We attribute the great change to the introduction of the Ruttan furnace in connection with the ventilation, thereby receiving a large amount of pure, outdoor air throughout every room. We have saved in coal alone nearly $800 per annum, and the furnaces are but little worn, and not a dollar has been spent on them for repairs since we first put them in the building—four years ago.

Yours respectfully, A. BAIN, *President Board of Education.*

NOTE.—This building was formerly heated by six ——— furnaces, in which they were obliged to use hard coal, at an enormous expense. We replaced them with *four* of our Tublar Furnaces, which are *especially designed for the use of soft coal*—hence the great saving in fuel.

At this date (October 1, 1881) less than twenty-five dollars has been expended for repairs, and furnaces are apparently as good as when set.

ONE OF THE MADISON UNIVERSITY BUILDINGS.

T. I. LACEY, BINGHAMPTON, N. Y., ARCHITECT.

Warmed and ventilated by the Ruttan-Smead System.

SOLDIERS' MEMORIAL HALL, TOLEDO, OHIO.

D. W. GIBBS & CO., TOLEDO, ARCHITECTS.

Warmed and ventilated by the Ruttan-Smead Apparatus.

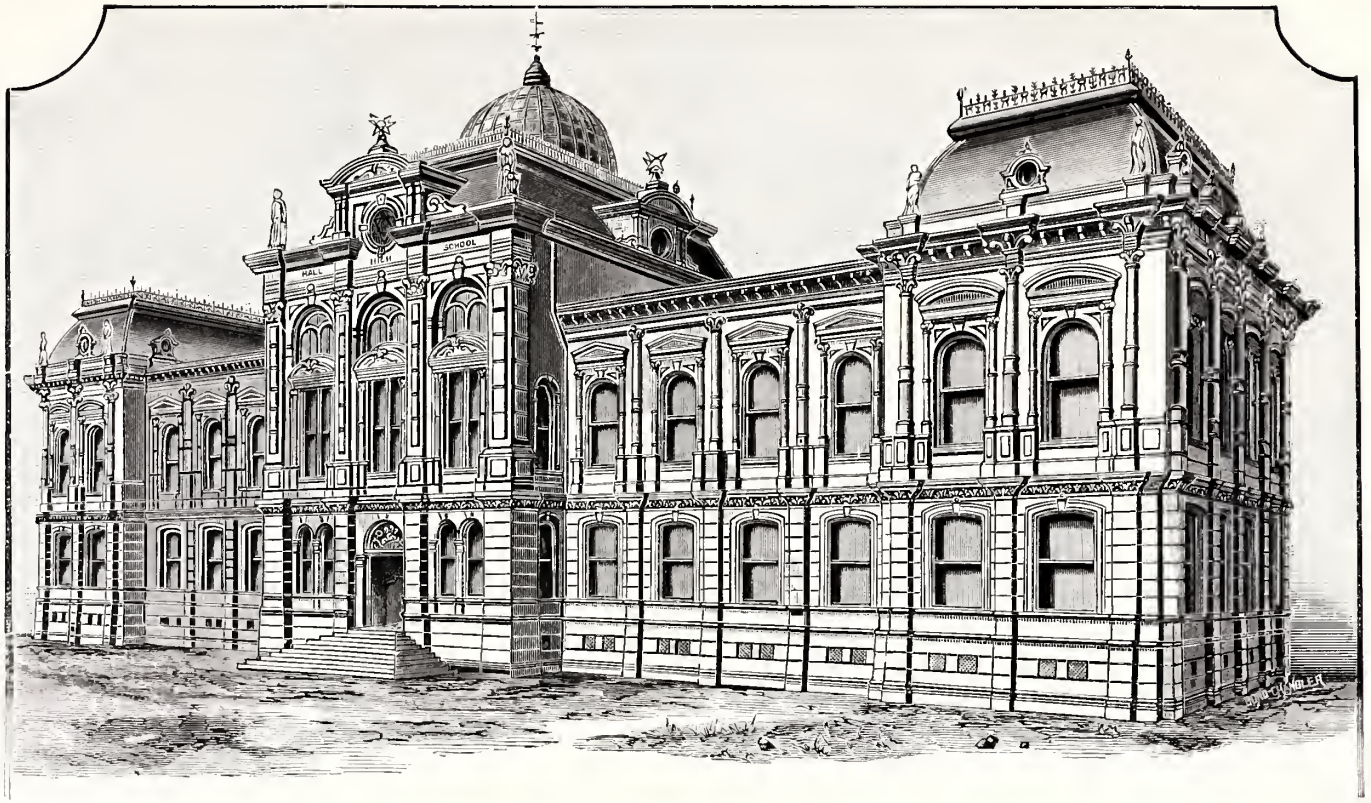
RESIDENCE OF M. W. DUNHAM, WAYNE, DU PAGE CO., ILL.

(IMPORTER AND BREEDER OF PERCHERON HORSES.)

The building represented above is warmed and ventilated with the Ruttan Apparatus.

PUBLIC SCHOOL BUILDING, DUNKIRK, OHIO.

Warmed and ventilated with Ruttan-Smead Apparatus.



BALL HIGH SCHOOL BUILDING, GALVESTON, TEXAS.

RUTTAN MANUFACTURING CO., Chicago, Ill.: GALVESTON, Texas, February 19, 1885.

Gentlemen,— * * * Our heating apparatus has turned out better than Mr. Fisher or I ever hoped. My standing invitation to the city is: "Pick out the coldest, most disagreeable day that comes along and come to the Ball High School and see how much more comfortable your children are than they could be at home." H. LEE SELLERS, *Principal of High School.*

FIRST BAPTIST CHURCH, HAVERHILL, MASS.

After our apparatus had been in use in above building one winter, the Haverhill Board of Education contracted with us to furnish apparatus for three School Buildings, and we also contracted with Trustees of Unitarian Church, Haverhill, to furnish apparatus for three large buildings.

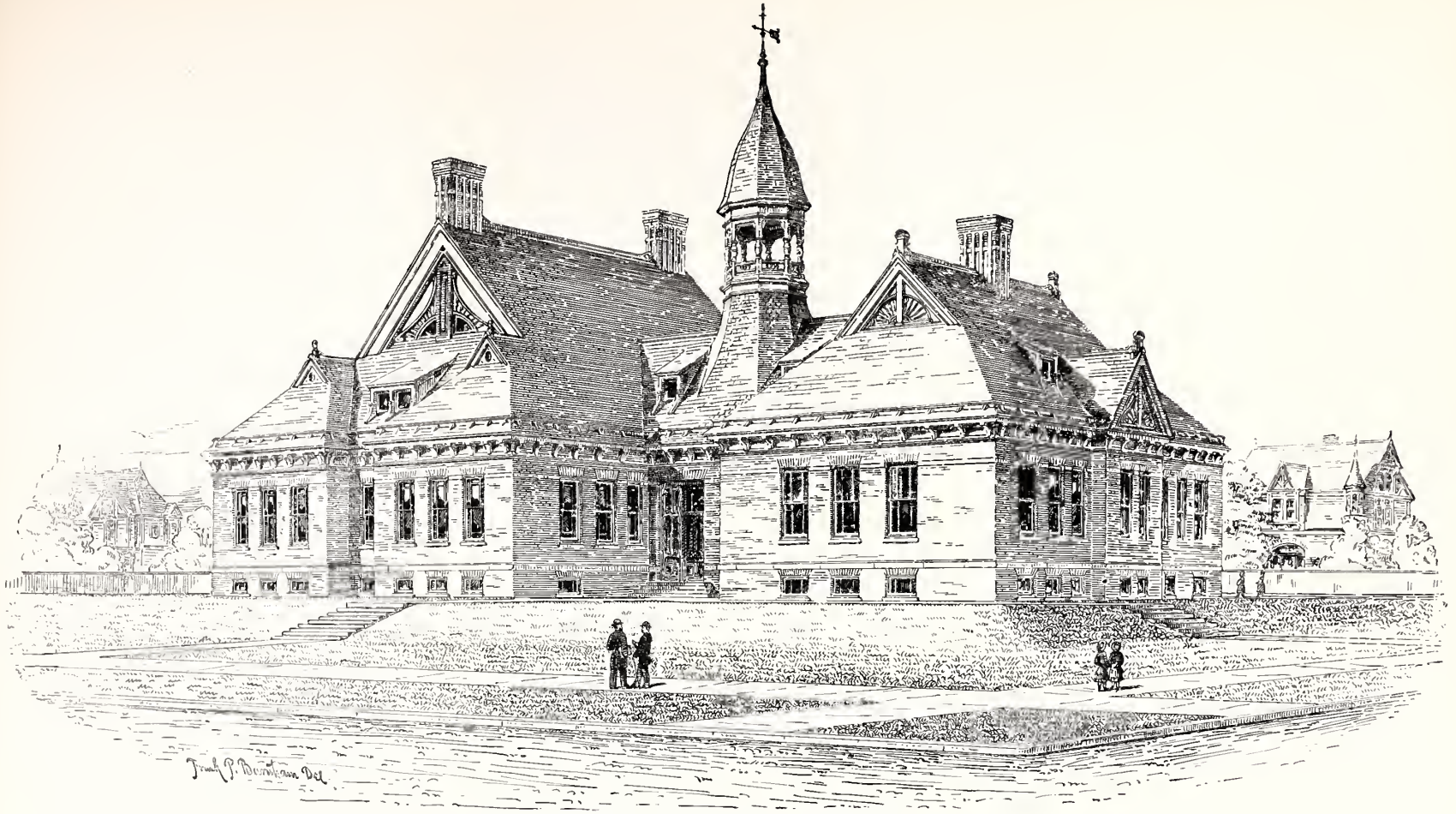
This work has been so satisfactory that the city of Haverhill has since awarded us three large school buildings. Other large work has been given us there, all giving most perfect satisfaction and to which we refer.

HAVERHILL, Mass., March 2, 1883.

* * * * We have run your furnaces all winter, and they have done *splendidly*. We kept the church warm while plastering, and mercury 10° below zero.

O. L. GIDDINGS, *Contractor.*

See also a letter from Haverhill regarding this work on page 110.



PUBLIC SCHOOL BUILDING EVANSTON ILL
EDBROOKE & BURNHAM ARCHT'S CHICAGO, & DENVER.

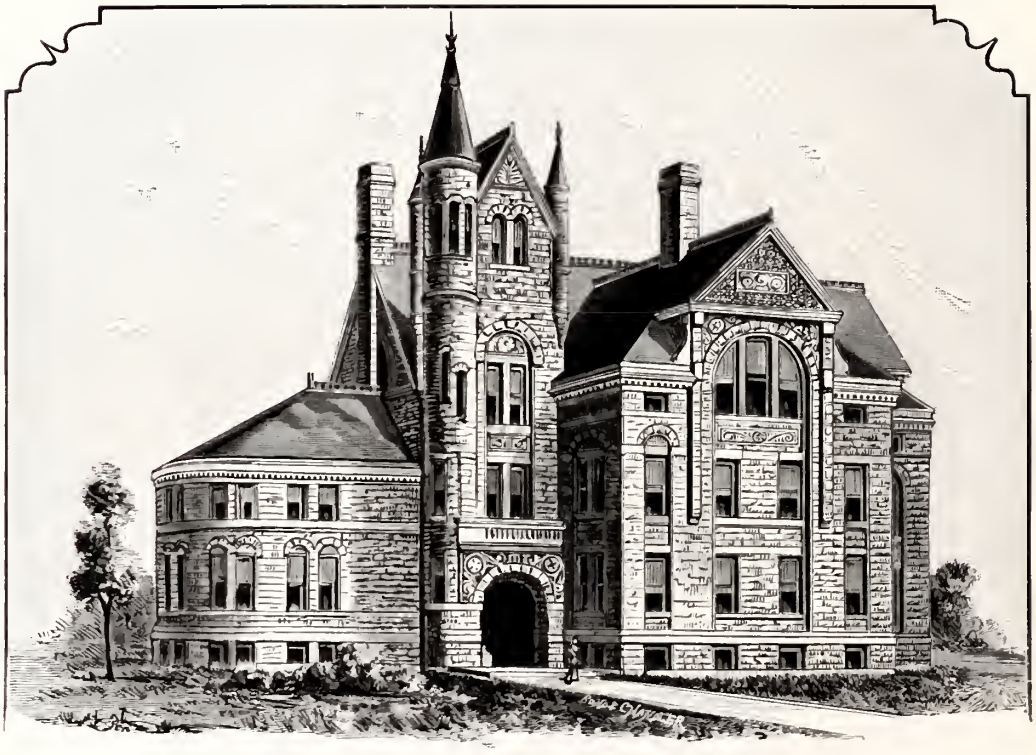
RUTTAN MANUFACTURING CO., Chicago:

CHICAGO, May 15, 1885.

Dear Sir,—The Board of Education at Evanston, Ill., have in use three of your Furnaces in one of the school buildings, together with your system of ventilation. The service performed has been entirely satisfactory.

Yours respectfully,

E. A. KIMBALL, *Chairman Building Committee.*



ONE OF THE COLLEGE BUILDINGS, OBERLIN, OHIO.

(RECITATION HALL.)

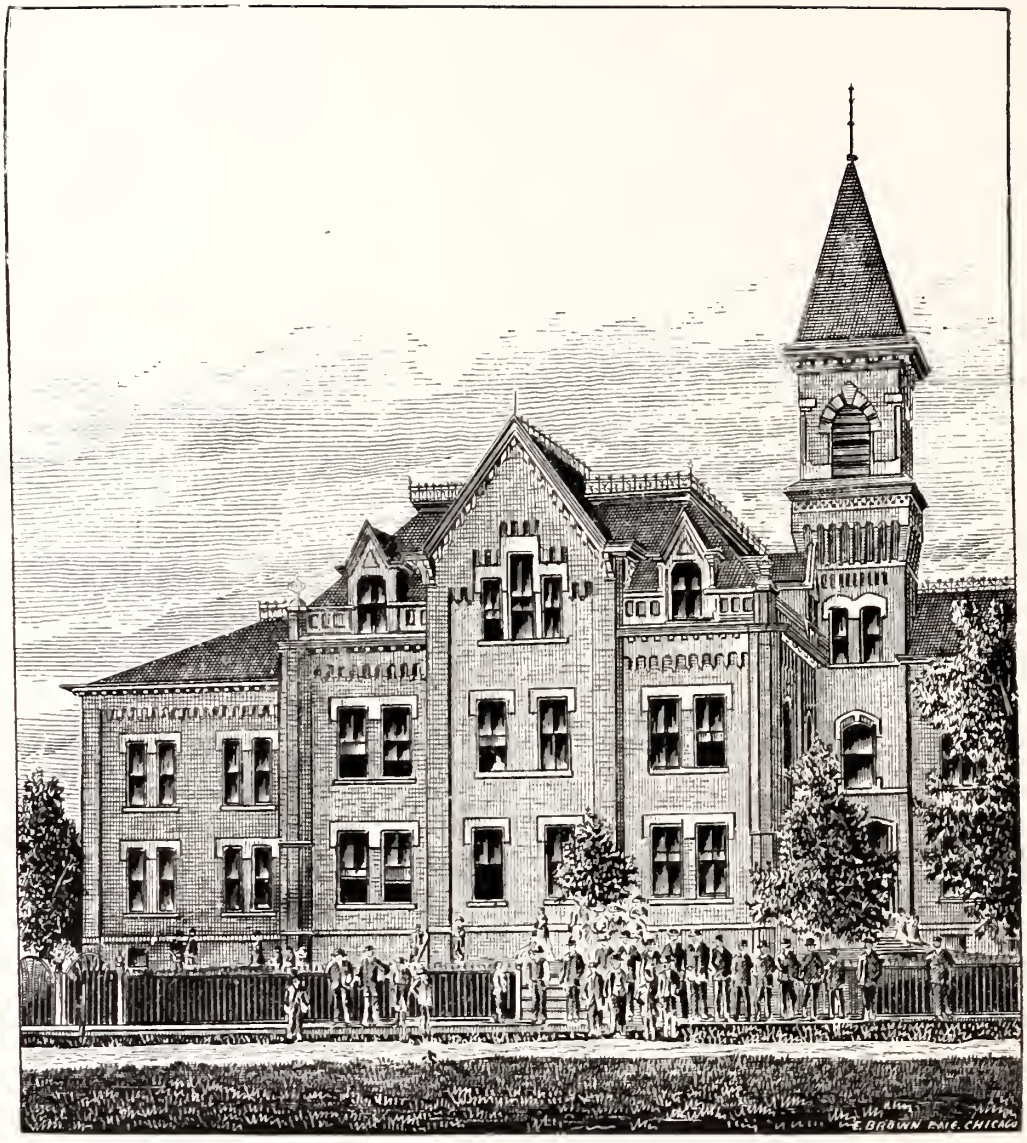
WEARY & KRAMER, ARCHITECTS, AKRON, OHIO.

The above building is warmed and ventilated by the Ruttan-Smead System. The Isaac D. Smead System of Dry-Closets are also introduced.

PUBLIC SCHOOL BUILDING, AURORA, ILLINOIS.

From the Aurora (Ill.) Beacon.

The ventilation and warming of many hundreds of the finest and most expensive buildings in the United States have been designed and very successfully carried out by them (RUTTAN MANUFACTURING Co.) in a great many cases where steam and other systems of heating and ventilation had been tried and had utterly failed. A full description of their system and apparatus, as given in their large Illustrated Book, would be found useful and instructive to every Board of Education. The work done by them in our West Side school building is certainly the finest we have ever seen. The building is practically provided with *lungs*. The Company is composed of men having a thorough scientific and practical knowledge of their business. We congratulate the Board of Education and the city upon this part of the work in the new building. From what we have seen, we would certainly recommend those wanting to secure for their buildings *the very best* warming and ventilation, that they see the RUTTAN MANUFACTURING Co. before completing plans or ordering work done.



HIGH SCHOOL BUILDING, DEFIANCE, OHIO.

In addition to above building, in which our system has been used five years, we have also furnished in Defiance apparatus for a Ward School Building, Masonic Hall, German Lutheran Church, City Hall, Defiance Academy, County Infirmary, and residence of Dr. E. N. Lewis and Benj. L. Abell, cashier Merchants' National Bank.

DEFIANCE, Ohio, March 9, 1882.

ISAAC D. SMEAD & Co., Toledo, Ohio:

Gentlemen,—I report the following in reference to our school, viz.: *The large twelve-room building* is heated by warm air from the Ruttan Air Warmers. The cost of fuel per annum is about 40 cents per pupil, and the cost of janitor is about 50 cents per pupil, all told, and *coal costs more per ton in Defiance than in either Toledo or Cleveland.* At a meeting of the School Board of our town, the Board authorized me to state that we think *and know* we have the *best heating and ventilating system we ever saw*, and highly recommend it to all parties wishing a good heating and ventilating apparatus.

By order of Board of Education.

J. H. BEVINGTON, *Secretary.*

STATE NORMAL SCHOOL BUILDING, RIVER FALLS, WISCONSIN.

(NEAR ST. PAUL, MINN).

The following correspondence will explain why we have introduced the cut of Normal University, located at River Falls, Wis.:

OFFICE FIRST NATIONAL BANK,
OSHKOSH, Wis., April 29, 1879.

ISAAC D. SMEAD, President Ruttan Manufacturing Co., Chicago:

Dear Sir,—The heating and ventilation of the normal building at River Falls is a complete failure. The Board, at its last meeting, instructed the Executive Committee to take such action as they thought best to have the defects remedied. Can't you go up there and look the thing over, and submit a plan, with price, *for good work?* I may go there within a few weeks, and would like to meet you at same time.

Yours truly, S. M. HAY, *Regent.*

STATE NORMAL SCHOOL, RIVER FALLS, Wis., April 2, 1880.

ISAAC D. SMEAD, Esq., President Ruttan Manufacturing Co., 68 Lake Street, Chicago, Ill.:

Dear Sir,—In response to your inquiry we have to say that, contrary to our preconceived notions, the results of your effort to warm and ventilate the normal school building, at this place, have verified your guarantees. The air is changed throughout the house three times per hour when the seven furnaces are fired. The air within is maintained at a temperature of 70° when the air without is at a maximum of 30° below zero. The air is supplied in a normal condition for respiration, and is distributed without appreciable currents in the inhabited rooms.

We can say that the Ruttan Furnaces have warmed and distributed 25,000 cubic feet of pure air per minute, without imparting to it any of the products of combustion that vitiate it for purposes of respiration, and without depriving it of any of its vitalizing properties, and these superlatively excellent consequences resulted from the consumption of only four-fifths of as much fuel as other furnaces required to yield results that were inferior in every respect.

We take pleasure, therefore, in commending your work to the consideration of any parties who are seeking for first-class results in warming and ventilating.

A. D. ANDREW, *Resident Regent.*
W. D. PARKER, *President of School.*

HIGH SCHOOL BUILDING, CANTON, OHIO.

WEARY & KRAMER, ARCHITECTS, AKRON, OHIO.

(For report of committee on warming and ventilation, see page 26.)

TESTIMONIALS.

IN presenting these testimonials, we are aware of the prejudice existing in the public mind against documents of this class, and therefore beg leave to call attention to the fact that many of these *were not written to us, or by any solicitation on our part*, but in reply to letters of inquiry from *third parties*, who either contemplated the erection of new buildings or the introduction of heating apparatus and some system of ventilation into old ones. As they are written *to parties* who were anxious to know the *whole truth*, and *by parties* who in most instances had, previous to the introduction of our work, used other furnaces and systems (?) of ventilation in the same buildings, into which ours were afterward introduced, we feel that their testimony should be considered as unimpeachable, as it is based upon experience, *and made by parties who are wholly disinterested as far as their relations to us are concerned.* Others are reports of committees or officials made to higher authority upon the subject of heating and ventilation, after a thorough test of our work.

Through courtesy to our competitors, we suppress the names of the furnaces or steam apparatus used previous to the introduction of ours.

We ask a fair, impartial perusal of the letters, and should further information be desired, we will take pleasure in furnishing it upon application.

OFFICE OF BOARD OF EDUCATION, DECATUR, Ill., December 8, 1884.

TO WHOM IT MAY CONCERN:

In the fall of 1867, we first purchased Furnaces of the predecessors of the Ruttan Manufacturing Company. Since that time there has not been a year that we have not bought more or less of the Company.

I take pleasure in saying that we have always received fair and honorable treatment. The managers of the Company have *always* endeavored to carry out every contract according to the spirit, as well as the letter. I very cheerfully recommend them to my friends, as gentlemen who can be *relied upon to do exactly as they agree in every instance.*

E. A. GASTMAN, *Superintendent of Schools.*

STATE NORMAL SCHOOL, MANKATO, Minn., November 26, 1884.

RUTTAN MANUFACTURING CO., Chicago, Ill.:

Gentlemen,—You wish to know how we like the Heating and Ventilating apparatus you put into our building a year ago last summer

It was thoroughly tested during the long, cold winter of 1883-4, and found entirely satisfactory in its heating power, and, under fair conditions, equally so in the matter of ventilation. All rooms not overcrowded with students have been well ventilated in cold weather, with the doors and windows closed. No means of ventilation can render the air, as it ought to be every three or five minutes, in some of the rooms containing classes two or three times larger than they should be, save powerful steam fans or a northern blizzard blowing through open windows.

I think your claim that the air is changed in a room every fifteen or twenty minutes is justified by our experience.

Your system of ventilation (exhaust) is the true one, and your Furnaces are large, durable and easily managed. Upon the whole, our experience with them is but a repetition of the satisfactory experience of the four normal schools of Wisconsin, familiar to me a few years ago.

Very truly yours, EDWARD SEARING, *President.*

MERCHANTS NATIONAL BANK, CEDAR RAPIDS, Iowa, January 2, 1885.

RUTTAN MANUFACTURING CO., Chicago, Ill.:

Gentlemen,—In reply to yours of 31st ult., we have three large school buildings heated and ventilated by your system, and I am pleased to say that both the heating and the ventilating are a grand success. Should our city build another school building the coming year, your admirable system will undoubtedly be adopted. The writer has been a member of the Board of Education of this city for the past ten years, and during that

time many methods of heating have been tried, and I can truthfully say none have given the satisfaction that your system has. Ventilation is an important feature in your system. There is no system for both heating and ventilating known to me that will compare with yours.

I am yours, etc., M. A. Higley.

May, 1885. We have since been awarded the building mentioned in Mr. Higley's letter.

Hastings, Neb., March 6, 1885.

Dear Sir,—Yours of recent date received, and should have been answered sooner but for crowding work. In reply, I am very happy to say that the Ruttan Furnaces you put in the high school have given us the greatest satisfaction. During December, January and February just closed, we had some unusually severe weather, very cold indeed, with terrible winds from north and west. But after the janitor got to understand the proper adjustment of the fires, there has been no day when the building has not been entirely comfortable, all the four lower rooms being never less than 70°, and many times 82° and 84°; while, on Monday mornings, we have sometimes let the thermometers run up to 90° odd, for a time, until the rooms were thoroughly heated after standing over Saturday and Sunday without fire. The upper rooms, including the large high school room and its adjoining recitation room, my own office, and the halls of both the floors have been perfectly warm, pleasant and comfortable for pupils and teachers. The ventilation has been perfect. No gas, no bad odors, no headache, have troubled us, for the constant changing of the air in from 20 to 25 minutes has kept it pure and wholesome.

I am greatly pleased, and am satisfied the Ruttan will warm and ventilate any building if properly put in and tended. Very truly yours,

F. W. Parsons, *Superintendent.*

Ruttan Manufacturing Co., Chicago, Ill.: Aledo, Ill., November 19, 1884.

Gentlemen,—In reply to your request, asking information as to how I like my Furnace, I will say I am well pleased with it. I consider it the most economical method of heating I have ever tried, and it certainly is the most satisfactory. The Furnace was put in in the fall of 1878, and has been in use every winter since, and my total outlay for repairs has been only $1.75, and the Furnace looks, to me, as though it was practically as good as new. The fuel account is materially less than it would be to heat the same rooms with stoves.

Very truly yours, etc., J. W. Edwards.

G. L. Cole, Esq.: St. Joseph, Mo., March 1, 1884.

Dear Sir,—In answer to your favor of the 24th, will say that we have only one of our school buildings (seven rooms) warmed by steam, in use now a little more than a year, and one (a six-room building) warmed by the Ruttan System in use since January 1, 1884. In the former (or the one warmed by steam) we are able to obtain scarcely any ventilation, the atmosphere at times in the various rooms being very unpleasant. The heat in the said building we find insufficient for the comfort and welfare of the pupils in extremely cold weather. In the building warmed by the Ruttan System we have apparently *perfect ventilation,* and can maintain any degree of temperature in each and every room (up to 100° if desirable) during the severest weather, the temperature of each room being directly under the control of the teacher in that room without interfering with the temperature of either of the other rooms. There are other minor points in my opinion that give the Ruttan System superior advantages over steam. Therefore experience and observation compel me to be very pronounced in favor of the Ruttan System over steam for heating and ventilating school buildings. Yours truly, F. G. Hopkins, *Chairman Building Committee.*

Having carefully read the above letter, we heartily recommend every word of it.

Chas. G. Ernest, *Chairman Supply Committee.*

John M. Armstrong, *Chairman Finance Committee.*

W. C. Dodge: Mt. Carroll, Carroll Co., February 17, 1882.

Sir,—Your favor asking about expenses of repairs is at hand, and am happy to be able to say *we have never had occasion to call on the Ruttan Company to do any repairing for us in all the time we have used their furnaces, put in in* 1876. We have had some sections of grates to replace. If I could have seen to the furnace fires myself, or always been certain of a trusty fireman, no repairs at all would have been needed. All that ever has been done might have been avoided with reasonable care and exercise of ordinary common sense. We all know the ashes should be kept from under the grate to admit a current of air; otherwise the grate will soon burn out. This is just what happened with ours. We use anthracite coal mainly (some wood), and the heat is, of course, very intense at times, and through the carelessness of the boys who tended the fires (probably too indolent to take up the ashes when they ought), the grates became so heated as to warp and then break. There is, however, no trouble in replacing them, as they are in sections just laid loosely in sockets made for them, and any person can replace them. So far there is no appearance of anything else giving out in our furnaces. The average cost per year since we have used the Ruttan Furnaces will *not exceed four dollars for the repairs named.* These furnaces are designed for soft coal or wood, although we burn hard coal, as it costs less here.

With best wishes for success in the introduction of the furnaces, and fully believing you cannot do better with any heating apparatus than the Ruttan, I am, sincerely, F. A. W. Shimer.

C. B. Tompkins, Supt. Education, Elmira, N. Y.: Haverhill, Mass., March 8, 1885.

Dear Sir,—I beg your pardon for delay in responding to your letter of inquiry in regard to the Ruttan-Smead Ventilating and Heating Furnace. At the time your letter came I was confined to my house and therefore unable to get the report of facts, etc., from the Prudential Committee. The kind of fuel we use is the Piction coal (bituminous), and use pine wood in starting a quick fire. *We start the fire in three furnaces at 7 o'clock on Sabbath morning, when the weather is cold, and at* 10 *o'clock, the time of service, our church and chapel are easily heated to* 65°. The cost of coal to us here is $4.50 per ton, and it will take from one to one and one-half tons per day. The main auditorium will seat 1,000, and the chapel seats from 500 to 700. One of

the grand points attained with this furnace is, that every part of the house is at a uniform temperature. The feet are just the same degree of heat as the head or the air at the floor the same as at the ceiling, and the ventilation is perfect, pure, fresh air all day, and you cannot if you would breathe the same air but once—the stale air going out doors and the fresh air coming in to take its place. I think, and so do the Prudential Committee, that the new method is a saving of very nearly one-half the expense in producing the same amount of heat. But our fires have been so irregular this season, for all purposes, it is quite difficult to get at the true cost of heating in average years. Allow me to say that our Building Committee, as well as Prudential Committee of our church, are more than satisfied with the Ruttan-Smead Ventilating Furnace, and that the claims of the proprietors have been fully sustained, and for heating churches and public buildings it has no competitors. I am with great respect, very truly yours,

CHAS. B. EMERSON, *Building Committee.*

RUTTAN MANUFACTURING COMPANY, Chicago, Ill.: SAYBROOK, Ill.

Gentlemen,—Accept our thanks for the good thing in heating and ventilating you have done for our church. The furnace, a No. 6, which you placed in our church last December, is a success in every way. It is economical in price and fuel—is a powerful and quick heater, and is easily managed. It is free from dust, smoke and coal odors. The draft, ventilation and heating are all complete. The pure air and uniformity of temperature, and freedom from cold currents through the whole building, make the heating and ventilation most satisfactory and praiseworthy. Should you desire any references, I would refer you to everybody here; we are all pleased. The amount of coal used is a marvel of economy. I regard the ventilation (as well as heating) a monument of Christian civilization, as well as common sense.

Yours truly, JOHN A. KUMLER, *Pastor M. E. Church.*

MINNEAPOLIS, Minn., June 1, 1885.

OTIS JONES, ESQ., President Ruttan Manufacturing Co., Chicago, Ill.:

Dear Sir,— In answer to your letter of inquiry as to how I am pleased with your Warming and Ventilating system, I take pleasure in saying that I believe it to be the most perfect and complete system of heating and ventilating I know of. My house is large, some *sixty* by *eighty-five* feet, *three stories*, with basement under all. Although the past winter was exceedingly cold, I found no trouble in keeping all the rooms comfortable and warm. I also consider it much more healthful than any other system, owing to the warm air being so evenly distributed over the whole house and the foul air being continually carried off, fresh air without taking its place, making a continuous fresh air circulation throughout the house. I also believe it to be the most economical. Yours truly, JOHN EDWARDS.

MILTON COLLEGE, MILTON, Wis., April 20, 1885.

MR. OTIS JONES, President Ruttan Manufacturing Co., Chicago, Ill.:

Dear Sir,—During the past fall and winter terms, the building of this institution, in which are conducted the recitations of our classes, has been heated with two of your Furnaces, No. 7. For some time previous, all the rooms, seven in number, have been supplied with wood stoves. This change in the method of heating has contributed very greatly to the comfort of both the faculty and the students. During the past unusually severe winter, we have experienced no difficulty in maintaining the temperature of about 70 degrees Fahrenheit in all portions of this building, though it is located on a rise of ground exposed to the sweeping winds of this region. Rooms which we have not been able to warm hitherto sufficiently in the coldest days, especially on the western side, have given us no trouble the past winter.

With your furnaces we use, also, the Ruttan system of ventilation. We cannot praise too highly the results of this system. It has aided materially in securing the uniform warmth of the building. The rooms, after being occupied with our classes during the day, have shown that they were filled with pure air when the last recitations have closed. The health of all, both teachers and students, has never been better in the winter than during the past term. Although one hundred and seventy persons have performed their school work during the day in these rooms, only one of this number has been seriously ill, and he caught a severe cold while stopping at a house for a short time, attending to some business on the farm. Steady and vigorous study and uniform attendance upon the recitations have characterized all the classes.

Yours very truly, *W. C. WHITFORD, *President of Milton College.*

RUTTAN MANUFACTURING CO., Chicago, Ill.: OTTAWA, Ill.

Gentlemen,—I have used your system of ventilation and warming for a little more than eight years. I am ready to say that it is a complete and thorough success. My house is a brick house. During all the rains and damp weather it is so dry that not a particle of mold or moisture is seen from cellar to attic, and yet the circulation of air was such that, during the summer heat, my house is cool; and both winter and summer the air all over the house was as pure as that out of doors. I kept from two to five rooms warmed nicely, with about the same amount of coal that five stoves would use, but I get rid of all the dirt and dust, and the trouble of taking care of so many stoves, and the heat I get is a summer heat instead of a burned air. When we get up in the morning there is no lassitude, no oppression of the lungs; the bedroom air is pure, and yet the floors are comfortable to the bare feet. In fact, I would not live in a house that was not built with your system of ventilation and warming. I would even build a house of only two rooms with it, rather than one of six rooms without it. Yours respectfully, E. Y. GRIGGS.

REV. J. A. KUMLER, Pastor M. E. Church, at Bloomington, Ill., recently wrote to Rev. H. C. Adams, pastor M. E. Church at Payson, Ill., making inquiries regarding the new church building just completed at Payson, and the following is quoted from Mr. Adams' reply:

"The heating and ventilating is perfect, there being only two or three degrees difference in the temperature three feet from the register and at platform. My babe sleeps on platform during service, and *never takes*

*Formerly State Superintendent Public Instruction.

cold. People come in with cold feet, take their seats, and soon are comfortable. If the room gets a little too warm, there is none of that hot, feverish feeling, that is the curse of so many churches not properly ventilated and heated. We had an accidental test of the ventilation a few days ago. I accidentally dropped a pine stick on the furnace, and, of course, the room was soon filled with smoke, but without opening a window or door, the smoke entirely disappeared in a very short time. There is very little coughing in the congregation, and I attribute it to the purity of the air. Furnace is all right. I would never let a church be heated in any other way if I could help it. On the coldest Sabbath I built a fire at 7:30, and at 9:30 was ready for Sunday-school, with mercury at 70°. The Congregational Church, heated with a ——— furnace, fired up at 4 A.M., and at 11 A.M. was not comfortable."

REED'S TEMPLE OF MUSIC, 136 State street, near Madison, Chicago.

GEO. D. CLAFLIN, Secretary Blade Printing Co., Toledo, O.:

Dear Sir,—We cannot commend the Ruttan Furnace too highly. It has proved all and more than represented, and pleases far better than anything else we have ever tried and we have tried several kinds, including expensive steam apparatus. We find no trouble in heating our entire building, even with the thermometer at 15° to 20° below zero, at far less expense to us than by any other system of heating. It is decidedly A No. 1, and we would not be without it.

Respectfully, A. REED & SONS.

This building is 25x100 feet, and four stories high.

From the Annual Report of the Chicago Board of Education.

Four new buildings were in process of construction at the beginning of the school year. These were the new Walsh, Longfellow, Sangamon Street and Lawndale. All of the above named buildings are heated and ventilated by the Ruttan furnaces. Five new buildings have been commenced during the year, namely, Keith, Webster, Irving, Ogden and the New Wells. The Ogden school building will have eighteen rooms, the other four fifteen rooms each. All of the above named school buildings will be heated and ventilated by the Ruttan furnaces. * * * * * * The Ruttan System of heating for school buildings is very successful and makes good ventilation an unavoidable occurrence. Hence these school houses will be much better heated and ventilated than any of our old buildings heated with furnaces of other patterns.

The poor ventilation in many of the older buildings has become notorious. The necessity of improving it has engaged the serious attention of the Board, from time to time, and particularly during the past two years. The Ruttan heating apparatus, which was put into the Calumet Avenue school during the previous year, had so fully demonstrated its capacity to make good ventilation that the Board in July and August, 1882, ordered it to be introduced into the Kinzie, Lincoln Street, and old Walsh buildings. During the past severe winter these schools have been heated and ventilated in a satisfactory manner. The ventilation has been very noticeably improved. It is safe to say that in these buildings the volume of fresh, warm air introduced into the school rooms, and of foul air passing out, is twice as great as it was before the change was made.

Acting upon the experience of two winters, the Board, at the close of the year, has wisely ordered that the furnaces and diminutive flues of six other buildings shall be replaced by the Ruttan and the enlarged flues required for better ventilation. The buildings are the Burr, Vedder Street, Pearson Street, Polk Street, West Fourteenth Street, and the Old Cottage Grove. It is to be hoped that next year may witness the extension of this kind of improvement to many or all of the remaining old buildings heated by furnaces, whose ventilation is faulty. * * * * * * Some of the steam-heated buildings have ventilation even worse than any heated by furnaces.

OAKLAND SCHOOL BUILDING, CHICAGO.

CHICAGO, Ill., June 8, 1885.

Gentlemen,—You ask my opinion regarding the Ruttan Furnaces now in the Oakland School building. This building was erected in 1874 and was supplied by furnaces of another make which did not give us the desired amount of heat and almost no ventilation. After using them for two years they were taken out and replaced by two No. 7 furnaces made by the Ruttan Manufacturing Co. Our school building was an eight-room, two-story building. We continued to use the two furnaces with the best of satisfaction until the summer of 1880 when, our school accommodations being inadequate, we put on a third story making a twelve-room building of what was heretofore an eight-room building. By the advice of Ruttan Manufacturing Co., when we enlarged our building, we had the two furnaces replaced by four of their No. 7's and they have been in continuous use ever since, and *I give it as my deliberate opinion that we now have the best warmed and ventilated school building in Cook County.* We are able at all times to thoroughly warm our school rooms during the coldest weather, and the temperature has been as low as thirty-five degrees below zero. No teacher or pupil has ever complained of rooms being too cold, and the ventilation is all that could be desired.

One year ago we erected a new twelve-room school building, and our committee (influenced by the architect) concluded to put in steam heating as an experiment. The new school building has only six rooms finished and *we have used as many tons of hard coal to warm the six rooms* for the new building *as we have tons of soft coal to warm the twelve school rooms with the Ruttan Furnaces,* and I consider the ventilation in the old building where the furnaces are placed *much better* than in the new building where steam heating is used. I can truthfully say that for warming and ventilating school buildings *the Ruttan System of heating and ventilating is far superior to steam heating apparatus or any other* with which I am acquainted. Were we to ereet a new school building I should prefer this work with all their latest improvement to any I know of in this country. I have given the subject of heating and ventilating school buildings very careful attention, and I can truthfully say that I believe it to be the best system of any now in use.

Should any party question the above statements, I have only to say, visit our two school buildings during the coldest weather of next winter and you will not remain in doubt. Hoping this will be satisfactory, I am,

Yours very respectfully, JOHN R. HODSON,

Chairman Committee on Buildings and Grounds.

MADISON, WIS., November 25, 1884.

S. D. FISHER, Esq., Sup't Ruttan Manufacturing Co., Chicago, Ill.:

Dear Sir,—I have your favor of the 24th, soliciting my statement in respect to the Ruttan system of heating and ventilating.

You inquire, of course, more particularly with respect to the working of the Ruttan system in the main hall of the University of Wisconsin, with which as a regent and member of the executive committee I had considerable to do. I am able to state that the heating system works satisfactorily, and the ventilating is highly esteemed.

It requires for its most perfect working, as it seem to me, easy burning fires without pressing demand upon them, then the heat and ventilation must be both very agreeably provided. I take especial pleasure in commending the Ruttan Company, and yourself its Superintendent, to the confidence of any person with whom you may deal, because I found you in your transactions with us, zealous to do your work faithfully, and honorable in meeting every requirement in respect to it. Very truly yours, *WM. F. VILAS.

*Now Postmaster General United States.

OFFICE OF PRESIDENT OF BOARD OF REGENTS OF NORMAL SCHOOLS.

RUTTAN MANUFACTURING CO., Chicago, Ill.: PLATTEVILLE, WIS., March 6, 1885.

Gentlemen,—I have always had serious objections to write commendations of devices offered for sale to the public. But I feel that I might be omitting a duty to the public, and more especially to those seeking the best method of heating and ventilating school buildings, should I withhold the results of my observation and experience in warming and ventilating the four normal school buildings of Wisconsin. We have under our supervision four large school buildings, located in different parts of the state, each having a cubic capacity of over 350,000 feet, and a total enrollment of nearly 2,000 pupils.

When these buildings were erected they were equipped with hot-air furnaces or steam heating of different manufacture, some doing reasonably well for a time, but all lacking sufficient power when the atmosphere was at a low temperature, and all of them requiring constant repairs, and consequent annoyance and expense. In the summer of 1875 a new wing was added to the Oshkosh building. The Board of Regents, after a full and exhaustive investigation of different heating and ventilating appliances, concluded to adopt the Ruttan Furnaces and system of ventilation in this wing, with a special guarantee on the part of the Company to heat the building during the coldest weather, and furnish a constant supply of pure air.

This experiment proving entirely satisfactory and fulfilling all guarantees, the Board of Regents determined to adopt this system of heating and ventilation for all the schools under their charge; this work has been accomplished at considerable expense, but the results gained have amply repaid all expenditures. The Ruttan Furnaces now in use in the several buildings are as follows:

Platteville.....Seven Furnaces.
Oshkosh.....Eight Furnaces.
River Falls.....Seven Furnaces.
Whitewater.....Eight Furnaces.

We find the advantages gained by the use of this system over any others known to us to be as follows:

1st. With the large amount of radiating surfaces, and weight of metal which these furnaces possess, an ability to warm these large buildings during the coldest days of a Wisconsin winter.

2d. In connection with the admirable system of ventilation to furnish a constant supply of pure air to each room, tests have been repeatedly made, showing an entire change of air every thirty minutes.

3d. A noticeable improvement in the health of the school population since the change in the system of ventilation.

4th. By using brick hot-air flues instead of metal pipes, lessening the dangers from fires so often resulting from heated metal pipes coming in contact with woodwork.

5th. When the work is completed and ready for operation the expense, except for fuel, is practically at an end. We have no expense to keep the furnaces in repair since placing them in our buildings.

Very truly yours, J. H. EVANS, *Pres't Board of Regents.*

MR. OTIS JONES, President Ruttan Manufacturing Co.: OSHKOSH, WIS., December 13, 1884.

Dear Sir,—The Ruttan Heating and Ventilating Apparatus has been in use in this school since 1877. In that time it has heated the building thoroughly, at less expense than ever before, while the efficiency of ventilation is incomparably better. Had we the latest improvement by which the air of a class-room may be promptly cooled without cutting off the free flow for ventilation, nothing more could be desired. We attribute the superior heating power of the Ruttan Furnace in the past, to a feature you make no claims for in your circular, viz.: the perfect accessibility of the smoke flues, by which we can keep the flame in direct contact with the iron, instead of having to radiate through a thick layer of soot, a very poor conductor of heat. The only repairs we have made in the seven years is the cementing of the joints over the fire-box.

Yours truly, G. S. ALBEE, *President*

MR. OTIS JONES, Chicago, Ill.: WHITEWATER, WIS., December 1, 1884.

Dear Sir,—Mr. Rodgers was here Thanksgiving day, and seems to have done the work thoroughly and satisfactorily. We have found the Ruttan system of heating and ventilation a great improvement over anything we have previously tried. It provides abundant ventilation, and thus secures a constant supply of fresh and properly warmed air, which is the only proper way of heating public buildings. Both the heating and ventilation of our buildings have been entirely satisfactory since the introduction of this system.

Very truly yours, J. W. STEARNS, *President.*

RUTTAN MANUFACTURING CO.: WHITEWATER, Wis., November 24, 1884.

Gentlemen,—Your favor of the 11th inst., inquiring as to the working of the Ruttan Furnaces in the Whitewater Normal School, was duly received. The building was formerly heated by steam. While this served the purpose reasonably well, so far as heat was concerned, there was a lack of necessary ventilation, so much so that the health of the teachers and pupils demanded a change. After thorough investigation the board of regents selected your furnace, and gave you the contract. We have never regretted doing so. Though the building is on an eminence, and exposed to the north and west winds, *we find no difficulty in heating it in the coldest weather, and the ventilation is complete.* As regards economy and durability and power, your furnace is a success. Yours truly, T. D. WEEKS, *Resident Regent.*

W. C. DODGE, Esq.: RIVER FALLS, Wis., December 24, 1881.

Dear Sir,—Your note of inquiry of the 16th inst. came in my absence and I regret the delay of my reply. In many years' experience with schools it has seemed that three results must be assured in the matter of airing buildings; first, abundant air; second, pure air; third, air free from deleterious matter—all guided by such economy as public service dictates.

First expense and constancy of repairs, together with probable interruptions, of nice adjustment of fuel to changing temperature, preclude steam and hot water. Most furnaces impair their plate, light metal, and render the air (inadequate in amount) totally unfit for purposes of healthful respiration.

This was the negative state of mind that I occupied at the time I found it necessary in 1879 to discard $4,000 worth of apparatus, then in use only four years. I issued a circular of inquiry that year to hundreds of schools in Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota and Iowa; a second circular, more specific in character, brought evidence pointing to Ruttan so unmistakably that I determined to adopt Ruttan warming and ventilating, and now *after two years' use I am satisfied with the change.*

The secret of the qualities found in Ruttan is discovered in the amount of metal used and the complete method of circulating the warmed air. In these respects I may say the Ruttan Company removed 3,500 pounds of furnaces and introduced 35,000 pounds; used *nine windows*, each 3x5 feet for cold air, *instead of two such* used by the discarded furnaces, and all dimensions were similarly enlarged; air now enters the room at 100° to 150°, formerly 200° to 300° Fahr.—the air, 500,000 cubic feet, *is now held at* 70° *top and bottom of rooms*—with mercury outside doors at 40° above or 40° below, *the air is exhausted completely every twenty to thirty minutes, and is entirely free from deleterious gases*, and the most surprising result is found in the use of *less fuel than formerly* —made possible by holding uniform force, and in utilizing *all* the heat, instead of allowing its escape up chimney and into basement.

I consider *the Ruttan a perfect system of warming and ventilating.* To your interrogatories:

1. I have used steam and object to it on account of its first cost and cost of maintaining it, together with the constant fear of fitters and janitors, of accidents from frosts. Have used direct and indirect radiation—in this latitude we don't dare to trust to indirect alone.

2. Already answered. Ruttan requires only ordinary day-laborer intelligence in attendance, *and comparatively nothing for repairs.*

3. Ruttan costs here from one-half to two-thirds of cost of steam apparatus to do similar work; *is more economical in every respect than steam.*

4. You can't use any system of ventilation that does not assure ample exhaust, and I have no knowledge of any system that effects all the desired purposes like Ruttan.

5. No difficulty in working with or against the wind in our "blizzards" or our zephyrs.

6. No evaporation at furnace seems to be needful; temperature of air being comparatively low, and no occasion seems to call for saturation up to dew point or thereabout.

Anything I may have omitted, I will supply on application with pleasure.

Trusting your efforts will effect best purposes, I am, respectfully,

W. D. PARKER, *President State Normal School.*

STATE NORMAL SCHOOL, RIVER FALLS, Wis., April, 1885.

RUTTAN MANUFACTURING CO., Chicago, Ill.:

Gentlemen,—Replying to your inquiry as to the services performed by Ruttan Furnaces and ventilation applied for this school, I have to say:

1. The seven furnaces have been subjected to specially severe tests during the three past winters, and have been used during seven years. *The expenditure for repairs have been less than* $30.

2. The furnaces have afforded an abundance of moderately warmed, pure air, in all temperatures outside ranging down to 52° below zero, as indicated by self-registering spirit thermometer. The 9th day of January, 1884, afforded the severest test for the furnaces, when they warmed the building to 70° Fahrenheit, in the midst of a gale with the thermometer sinking from 18° below zero to 40° below.

3. I know no furnaces that afford air so thoroughly adapted for bathing the body and for respiration, as the Ruttan. They leak no gas, super-heat no air, and run without apparent deterioration under the minimum of attendance.

4. The admirable results of the Ruttan Furnaces are sure to gratify customers by reason of their large capacity, their delivery of heat just when it is needed, and their thorough economy in all respects.

Respectfully yours, W. D. PARKER, *President.*

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*This building *is nearly 500 miles northwest* from Chicago.

Extract from the Thirtieth (last) Annual Report of the Board of Education, Chicago, issued May, 1885:

"The heating and ventilation of the following school buildings have been satisfactorily perfected during the past year by the introduction of the Ruttan Furnace System—Division and Cleaver St., Headley, Pickard, Sheldon, Scammon (brick building), Ward and Wentworth Av.; and the heating and ventilation of the north half of the Lawndale school has been completed." * * *

"The improvements in the sanitary condition of the school buildings actually made and undertaken, during the past year, have been, it is safe to say, more numerous and radical than those of any previous year in the history of Chicago, *and probably they surpass any year's work in this direction ever done by any city in any land.* The *improvements in ventilation alone* have bettered the condition of more than 17,000 *different pupils.* Following is a statement of the more important changes:

"Thirteen old school houses having old style furnaces and defective ventilation, have had their heating apparatus removed and have received, instead, large Ruttan Furnaces with good fresh air supply. At the same time the old foul air ducts, such as they were, have been discarded and in their stead large shafts have been substituted. In the center of each large shaft stands an iron smoke-stack, which warms the air of the shaft, causing a rapid up-current, and consequent exhaust of the foul air from the rooms. At a moderate estimate the changes mentioned give each school room effected by them more than twice, probably three times, as much fresh air as they formerly had, and reduce in the same ratio the fouling of the air the pupils breathe. With the temperature outdoors at zero, Fahrenheit, the new apparatus put into these buildings supplies every pupil per hour an average of about 1,500 cubic feet of fresh air, while a corresponding volume of foul air is carried off. This statement is based on observations actually made with instruments of precision in the hands of experts who were entirely unconnected with the builders of the machinery.

"In six buildings the work was completed in time to be tested during the severe weather of the past winter, when it gave entire satisfaction, and great comfort to the teachers and pupils.

"There attended these thirteen schools during the past year, upward of 13,000 different pupils. These children have, by the improvements made, passed from a stuffy and impure air into one approaching the ideal for an occupied room."

Extracts from Minutes of Chicago Board of Education, January 11, 1883:

"Mr. Garvy, chairman of the Committee on Buildings and Grounds, presented the following:

To the Board of Education of the City of Chicago:

"*Gentlemen,*—Your Committee on Buildings and Grounds respectfully report that, on September 7, the Board directed the preparation of plans for a fifteen-room school building to be erected on the lot corner Wentworth avenue and Thirty-third street, with a view of using steam for heating and ventilation.

"Your committee, after a careful consideration and investigation of the most economical method of heating school buildings, are of the opinion that while steam, in comparison with the Ruttan System, is about three times as expensive to introduce and nearly twice as expensive to operate, the temperature and ventilation of the class rooms are fully as good from the Ruttan Furnace system as from steam heating.

"Your committee would therefore ask authority, in giving the architect instructions to prepare plans for the above described building to adopt the Ruttan System of heating and ventilation for said building instead of steam, as at present ordered by the Board.

John W. Garvy, } *Committee on*
M. J. Dunne, } *Buildings and Grounds.*

"Mr. Story moved to concur in the recommendations of the committee.

"Mr. Hoyne moved that the consideration of the question be postponed to next meeting of Board.

"The motion to postpone was carried."

From Minutes of Next Meeting, January 25, 1883:

"Mr. Garvy, chairman of the Committee on Buildings and Grounds, called up the report of the committee presented at the meeting held January 11, 1883, recommending that the new building to be erected corner Wentworth avenue and Thirty-third street be heated by the Ruttan Furnace System instead of by steam.

"On motion of Mr. Dunne, the recommendation of the committee was concurred in."

This is the very strongest commendation of the Ruttan System and Ruttan Air Warmers, and was given after a two years' trial of our work.

Office of the Board of Education, District No. 2,
Denver, Colorado, April 26, 1884.

Louis Rochat, Atchison, Kansas:

Dear Sir,—In reply to yours of the 14th inst., I would say that we have in our city six school buildings heated by the Ruttan System, four that are heated by steam, and several by the hot air system, and we consider the Ruttan System of heating and ventilating superior to all of them, both in economy and results.

The Central School is a six-room building, erected in 1880, and heated by two Ruttan Furnaces, which cost us $1,350, whereas the lowest bid we were able to get to heat it by steam was $1,850. The cost of repairs on these to date (three years) is $17. * * * * The amount of coal charged to this building last year was $278.25.

The Ebert School is an eight-room building, erected in 1880, and is heated by steam. The expense for repairs alone on the apparatus last year was $118.50. The amount of coal charged to the Ebert for the last year was $531.90.

The Franklin School * * * contains thirteen school rooms, Superintendent's office, two wardrobes to each room, a Director's office and two very large halls * * is heated by four Ruttan Furnaces and has been in use one winter—no expense for repairs. The amount of coal charged to this building for the year is $510. An exact record was kept for the month of January last, and the building was warmed twenty-six days and consumed nineteen tons of soft coal.

The Gilpin School is a twelve-room building and is heated by steam; was built about two years ago. The expense for repairs on heating apparatus last year was $148, and the amount of coal charged to it was $744.25.

The Longfellow School is an eight-room building, heated by the hot air system. It cost for fuel last year $494.39.

The Fairmount School is a six-room building, heated by the Ruttan System for two winters, and no expense for repairs. It cost us for fuel last winter $220.50.

The other three buildings heated by the Ruttan System have been in use one and two winters with no expense for repairs, and the amount of fuel used is substantially the same as those given. I think the record of the buildings mentioned sufficient to establish the fact that the Ruttan System is the most economical in three things: first cost, fuel and repairs, besides having the advantage of giving *better results in ventilation*. We have two men on our board who are practical steam men, and thoroughly understand the steam system, and they are opposed to the use of steam where heat and ventilation only are required. * * * They are at the head of the Denver & Rio Grande shops * * * * and are perfectly aware of the petty annoyances of burnt crown-sheets, leaking flues, sediment deposits, condensation of steam in pipes, freeze-ups, bursting pipes, leaking joints, etc., etc., to say nothing of its first cost. In conclusion, let me say that there comes a time in the history of every boiler when it must come out either for repairs or to be replaced by a new one, either of which is very expensive, while everything connected with the Ruttan System that is liable to wear out can be replaced at small cost and without detriment to the building or furnaces.

Please excuse delay, as I wished to examine the books before answering, so as to give exact figures.

We pay five dollars and twenty-five cents ($5.25) per ton for soft coal.

Respectfully yours, A. D. Shepard, *President of the Board.*

During a recent contest at Atchison, Kansas, the following statement was made to the Board of Education of that city, by those trying to secure the introduction of Steam Heating Apparatus, to-wit: "If you "want something that costs more to begin with, but less for fuels and repairs, put in steam; but if you want "something that is cheap in the first cost, but very expensive afterward, put in the Ruttan Furnaces." In reply to this we said: "If that is true, you certainly do not want the Ruttan System, and therefore we "request that you correspond with those using both, and learn from their experience." Mr. Rochat of that board wrote to Denver, asking about the two systems, especially as to the *cost for fuel, and repairs* on the heating apparatus, and received the letter hereto attached in reply. It was written without solicitation on our part, and is published by permission. By analyzing it you will find the following tabulated statement to be true, figured on the basis that the heating apparatus was used six months of the year, to-wit:

Name of Building.	No. of Rooms.	How Heated.	Cost of Fuel per Year, At $5.25 per ton.	Cost of Fuel per Month per Room.	Cost of Repairs on Heating Apparatus per Year.
Central School	6	Ruttan System.	$278 15	$ 7 73	$ 5 66
Eberl School	8	Steam.	531 90	11 08	118 50
Franklin School	14	Ruttan System.	510 00	6 07	Nothing.
Gilpin School	12	Steam.	744 23	10 03	148 00
Longfellow School	8	Hot Air System.	494 39	10 29	Not given.
Fairmount School	6	Ruttan System.	220 50	6 12	Nothing.

Average cost to heat rooms per month by RUTTAN SYSTEM	$ 6 74
Average cost to heat rooms per month by Hot Air System	10 29
Average cost to heat rooms per month by Steam	10 70
Per cent saved by using RUTTAN SYSTEM	37½

☞ *Also please note the difference in cost for repairs.*

PUBLIC SCHOOL BUILDINGS AT ROCHELLE, SHELBYVILLE, TUSCOLA, ILL., AND MICHIGAN CITY, IND., ALL WARMED AND VENTILATED BY THE RUTTAN SYSTEM.

Ruttan Manuf'g Co.: Rochelle, Ill., May 11, 1885.

Gentlemen,—Your favor of the 11th duly received. In reply to your inquiry, the Ruttan Furnaces in the public school building, also in the Presbyterian Church and Opera House, are giving *good satisfaction*, and doing the work required of them to the satisfaction of all parties.

Respectfully yours, A. Bain.

HIGH SCHOOL BUILDING, PRINCETON, ILL.

W. D. Parker, River Falls, Wis.: Princeton, Ill.

We have five No. 5 Ruttan Ventilating and Heating Furnaces; three in one building and two in another and in addition our High School Board have purchased three more for use in high school building (formerly heated by the old style hot-air furnaces). It is next to impossible to get the janitors to use little enough coal. They keep the rooms too warm. A very small fire in a No. 5 furnace will warm two rooms thirty feet square. In an hour we can warm any of our buildings in the coldest weather to 70°. As a heater and ventilator, the Ruttan Furnace is the best I know of, and indeed, the only satisfactory one. *I like it better than steam.*

Respectfully, C. P. Snow, *Sup't City Schools.*

S. L. Bailey, Chicago, Ill.: Cherokee, Iowa, April 6, 1885.

Dear Sir,—We have the Ruttan System of heating and ventilation in our new $20,000 house. With our four furnaces we are able to warm all the rooms in the coldest weather, and to keep the air in them pure all the time.

I feel confident that we have the best system now in operation.

Very respectfully,

Geo. T. Foster, *Sup't City Schools.*

Boone, Iowa, June 4, 1880.

Secretary Board of Education, Cedar Rapids, Iowa:

Sir,—Yours of the 1st received and contents noted. We are using both steam and the Ruttan System in our school buildings.

Our high school building was especially arranged for steam; boiler-room was marked upon the ground plan. Both give us a sufficient heat. Our steam *does not* secure good ventilation, nor can heat by it be obtained in a short time. *The Ruttan Heaters secure use good heat and the best of ventilation.*

The expense for heating three buildings with the Ruttan Heaters, where we have had during the year nearly 400 children, has been but little more than one-half what it has been with steam in one building where we have had 226 pupils. The case is this—with Ruttan it is five days each week, say eight hours per day; with steam it is seven days per week, 24 hours per day. As it has been with us, I must say I would prefer the Ruttan.

Very respectfully,

W. P. Todd.

P. S.—When our high school building was erected in '78 I was in favor of steam.—T.

Engineer Department, District of Columbia,
Laboratory of the Chemist,
Washington, February 26, 1885.

The Honorable Commissioners, District of Columbia:

Gentlemen,—I have the honor to report that in compliance with directions of Commissioner General J. R. West, to make tests and analyses of the atmospheric air of the "Twining" and "Banneker" school buildings, I have performed and make the following statement:

On the 17th inst. I made some tests in both of these buildings, which lead me to the following conclusions as to the normal condition of the air therein. The tests made in the Twining building were in School No. 9, on the third floor, containing 56 white children, and in School No. 6, on the second floor, containing 57 colored children. On the 25th inst. I returned to the Twining building in order to make a quantitative analysis of the air.

The process followed by me is that laid down by Boussingault, based upon the absorption of carbonic acid by caustic potash and moisture by strong sulphuric acid, and finally the absorption of oxygen by copper, etc.

The result of these analyses (taking the air from various heights in the school) are as follows:

Outside air.....	000.03	Carbonic Acid.	23.00	Oxygen.	By weight.
Air Banneker School.....					
Air Twining School No. 9.....	000.045	" "	22.94	"	

It is therefore concluded that the air in the Twining School is of normal condition, which is attributable to good ventilation of the rooms.

It is the atmospheric air which is brought in a large volume by the heating apparatus from outside into these buildings; and the hot air of the rooms finding an outlet into cold conduits, effects a constant renewal of air. Herein lies the secret of the small quantity of carbonic acid found in the rooms thus ventilated.

This report refers more particularly to the Twining building. I intend to again visit the Banneker building and make an additional analysis of the atmospheric air therein, the report of which will be forwarded hereafter.

Very respectfully,

E. J. DeSmedt, *Chemist, District of Columbia.*

Engineer Department, District of Columbia,
Laboratory of the Chemist,
Washington, March 3, 1885.

The Honorable Commissioners, District of Columbia:

Gentlemen,—Yesterday I again visited the Banneker School building, and made there a quantitative analysis of the air in Room No. 4 on second floor, while occupied by 52 colored children and one teacher.

Result of analysis by weight:

Carbonic Acid—000.04 per cent. Oxygen—22.98 per cent.

This air is of normal condition.

Very respectfully, your obedient servant, E. J. DeSmedt, *Chemist, District of Columbia.*

THE REPORT OF WASHINGTON (D. C.) COMMITTEE ON BUILDINGS AND REPAIRS.

At a Meeting of the Board, June, 13, 1882.

The Committee on Buildings and Repairs have to report for the information of the Board:

That since the last meeting, a proposition for furnishing an apparatus for heating and ventilating the Webster and Gale school buildings was submitted to the District Commissioners, and by them referred to this Committee for approval or disapproval.

A special meeting of the Committee was held, and the proposition with the plans therefor were considered, and unanimously approved, for the following reasons:

1. Because it guarantees a temperature of 70° *in the coldest weather*, thus preventing the possibility of having to close any of the schools on account of a lack of warmth, as had to be frequently done heretofore.
2. Because it provides for the admission of *double the quantity of fresh air* that the original plan did.
3. Because it provides means for the *admission of fresh air, even when the heat is shut off*, and without opening the doors or windows, which the original plan will not do.

4. Because it provides means for regulating the temperature of the rooms, by *the mingling of fresh cold and warm air at will*, which is not done by any other plans, either proposed or in use, so far as known.

5. Because it guarantees an entire change of air in each school room, once every twenty minutes, if desired, thus securing the most thorough ventilation.

6. Because it guarantees the District against any expense for repairs, except the burning out of grate bars, lining, and short smoke pipe, *for ten years.*

7. Because it is simpler and cheaper, both as to first cost and as to management, than any steam heating apparatus, and would prevent the possibility of loss by the bursting of coils, as well as the trouble arising from the want of proper management of the air valves, as in the present buildings.

8. Because the proposition *included the building of two brick ventilating flues in each building,* in accordance with the previous recommendation of the Board.

9. Because *it would save* $4,900 from the estimates made by the Inspector of Buildings, for the heating apparatus and the ventilating flues, in these two buildings.

10. Because one-fourth of the cost was to be retained until the apparatus had been tested one entire winter, and then, if not entirely satisfactory, the apparatus was to be removed at the expense of the parties furnishing it, and without detriment to the buildings.

It will be observed that several of the foregoing reasons are exactly in accord with the suggestions of the Special Committee appointed by the house of representatives on the 20th of February last; for in their report (on p. 3), in speaking of the Peabody, Force, Henry and U street buildings, they say:

"The principal defect, from a sanitary point of view, in all these buildings is in regard to the fresh air supply, which is entirely insufficient."

And again, on page 4, they say:

"The heating apparatus in these buildings is entirely insufficient to heat during cold weather the amount of air supply which should be furnished."

Again the report says:

"There is no provision in any building for diminishing the temperature of the incoming air without totally cutting off the supply of heat, and when the rooms become over-heated, as appears to be not infrequently the case, the only method of cooling is to shut off the heat and open the windows, thus creating drafts."

Your Committee would further state for the information of the Board, that nearly a year ago its chairman, becoming satisfied that a better plan than any hitherto in use here might be found for heating and ventilating our school buildings, set on foot an investigation on that subject; and finding that the proposed plan was in extensive use elsewhere, especially at the West, he prepared a circular of inquiry and sent it to the school authorities in various sections where this apparatus was in use. The result was a series of letters from the President of the State Board of Wisconsin, the professors in their normal schools, the principals of their high schools, the State Superintendent, the proprietor of the Mt. Carroll Seminary at Mt. Carroll, Ill., who also refers to their member of congress, Hon. R. M. A. Hawk, and from the business agent of the School Board at Chicago, all of whom testified in the highest terms to the success of the proposed apparatus as used in their schools.

This information had, from time to time, been laid before this Committee, and the matter had been fully examined and considered long before the proposition was referred to them by the District Commissioners; and it will therefore be seen that the Committee did not act without full knowledge of the subject when they recommended its adoption.

W. C. Dodge, *Chairman of Committee.*

WARMING AND VENTILATION OF CHURCHES.

TO those interested in the question of warming and ventilating church edifices we submit the following letters received by Mr. J. H. Puck, chairman of a committee appointed by the German Lutheran Church, of Toledo, to investigate, with a view of purchasing the best system of warming for their church that could be found, the one now in use having totally failed to heat the building.

J. H. PUCK, Esq., Toledo, O.: GENEVA, Ohio, April 28, 1885.

Dear Sir,—Replying to your favor of 25th in regard to the Ruttan Heating and Ventilating System as used by us, would say that we consider it the best of all in the circle of our knowledge of heaters. Our experience during the past winter has been that we could easily heat our church in the coldest weather, in fact the only fault we find is that our sexton keeps the room too warm. If we were to put in another would buy the Ruttan-Smead apparatus.

Very respectfully yours, C. W. KNAPP, *Secretary and Treasurer.*

J. H. PUCK, Esq., Toledo, O.: HARTFORD CITY, Ind., April 28, 1885.

Dear Sir,—Your favor of 25th inst. to hand. We have used the Ruttan-Smead Furnace for seven years in our church, 40 by 80, 35-foot ceiling. Have no trouble in making all parts of the house comfortable in the coldest weather, provided fire is started soon enough to allow all the air to pass through the furnace. I have served our church in all relations from sexton to pastor, and am perfectly free to say that the Ruttan-Smead System is the best of which I have any knowledge. All parts of the house, except the gallery, are of same temperature. If we were building again we would use the same heating system.

Respectfully, E. T. CHAFFEE,
President Board Trustees, Grace M. E. Church.

MR. J. H. PUCK: SIDNEY, Ohio, April 26, 1875.

Dear Sir,—The furnace placed in our church by Isaac D. Smead & Co., answers the purpose admirably The system is correct and your people can do no better. While the outlay may seem to them large it will be economy in the end. If you try to warm or ventilate your church without the change which Mr. Smead proposes, you will certainly fail, whatever furnace you may use. We regard the arrangements of our church for heating and ventilating eminently successful.

Yours truly, D. R. SILVER.

MR. J. W. PUCK: LIMA, Ohio, April 27, 1885.

Dear Sir,—Yours, making inquiries about the Ruttan Furnace, just received. In reply I have to say that we are well satisfied with the furnace. The heating and ventilation are as good as we could wish. Had it in use four years; is still in good condition.

Yours, etc., J. R. HUGHES.

J. H. PUCK, Toledo, Ohio: BLOOMINGTON, Ind., April 28, 1885.

Dear Sir,—Your favor inquiring about Ruttan Furnaces received. We are much pleased with ours. We have used it in our new Christian Church since February 1, and, of course, through some of the coldest weather of this cold winter. We find, with the thermometer 10 or 15 degrees below zero, the room can be comfortably warmed with one large register in from two to three hours. I am inclined to believe it to be the best thing to be had. Hastily, etc.,

AMZI ATWATER.

MR. J. H. PUCK: BELLEVUE, Ohio, April 29, 1885.

Dear Sir,—We put the Ruttan furnace in our beautiful new church, at Shelby, and I will, and must say for it that it is a great success, both for ventilating and heating. I am now stationed at Bellevue, and we expect to put the same furnace into our church here. I should put it in even at twice the cost of any other furnace that I have ever heard of, and I have made the furnace business a study for years. Mr. Smead is right in not letting his furnace go in without the ventilating flue, for one of the principal sources of its success is its system of ventilation. Yours truly,

(Rev.) GEO. L. HANAWALT.

MR. J. H. PUCK: CRESTON, Ohio, April 28, 1885.

Your letter just received this morning. Now, concerning the heater and ventilator, I will say this, that if you get any other heater (at least anything that ever I saw) you will not be satisfied. But if you get Mr. Smead's put in, although it is more expensive, you cannot help being satisfied. Our neighboring churches will remove their old heaters just as soon as they have the means. We can heat our church in an hour, with the mercury at 12° below. We have good, fresh, warm air, and a circulation of this fresh air all the time, and no headache. Our organization is just a year and a half old, and of course are not very far along financially, but we concluded we had better spend our money for something that was right at first, and in so doing save money; and I saw at first glance that the Ruttan-Smead Heater and Ventilator was got up on the correct principle for health, comfort, and economy. I can heartily recommend to you Isaac D. Smead's system, and I think you will never regret it if you buy. Cost is nothing, if you have something that will suit you. Remember that I have no interest in this heating concern, neither do I get paid for recommending, but that you may have a comfortable place to worship God. Yours,

G. W. LITTELL.

MR. J. H. PUCK, Toledo, Ohio: SHARON, Pa., May 2, 1885.

Dear Sir,—Yours of the 25th April at hand. Please excuse delay in answering, caused by press of work. You inquire about the Ruttan Ventilating and Heating Furnace. I can say of it, after a careful trial of it, during the past very cold winter, that it is the best heating apparatus that I have ever yet seen for use in church buildings, and I verily believe the best there is made, and the best possible to be made, because constructed upon the true principle of heating and ventilating combined. The success of the system depends entirely upon having the ventilating and smoke flues large enough and properly constructed. The expense is nothing compared with the comfort and delight experienced in having your church warm, comfortable and well supplied with pure air in the cold, bleak days of the coldest winter; beside, the expense of heating, when once you have the "System" in its completeness, is far less than by any other way of heating known to myself. During some of the coldest days of the winter just passed, when our school buildings, heated by steam apparatus, were compelled to be closed because they could not be sufficiently warmed in time for school, we could have our church as warm as on other times in the course of two or three hours, without in any way urging the furnace beyond the usual manner of heating. I think I can safely say that one-third of the fuel is saved by this system as compared with steam heating, to say nothing of the ease of heating, and delight in breathing at all times a fresh, pure, warm air. With best wishes for your success,

I am yours truly, H. C. HALL,
Pastor Sharon Baptist Church.

J. H. PUCK, Esq., Toledo, Ohio: DAYTON, Ohio, April 28, 1885.

Dear Sir,—Your favor of 25th inst. has been received. Mr. Smead contracted with us that for a certain sum he would put in apparatus to warm Christ Church, and he fulfilled his contract. We have no ventilating shaft, but have contrived a substitute by using the stairway to the steeple. This answers in but an indifferent manner. In justice to Mr. Smead I should state that he did not recommend or guarantee the performance of the ventilating shaft. We have had no trouble in keeping our church comfortable this winter, and you know we have had extremely cold weather. Trusting this will give the desired information,

Yours truly, J. LANE REED.

From the Examiner (New York), March 13, 1884.

DR. GOW'S VENTILATION EXPERIENCE.

Mr. Editor,—The method described by the second correspondent of March 6, comes very near the Ruttan system of ventilation. That system seems to come as near perfection as human frailty will allow. We have it in our new chapel. It is a building about sixty feet square and thirty feet high in the main room. A Ruttan-Smead furnace with the Ruttan system of ventilation heats it. We have already tested it in the essential points. When the thermometer is at 25° below zero we can make our rooms warm enough for public service in two hours, from 65° to 70°, as we wish. The thermometer, at a recent test, showed a difference of only 2° between the floor and eighteen feet above the floor. It is not necessary to open windows and doors to change the air in the rooms. The ventilating system gives a continual supply of air as sweet and warm as a June day, and as continually removes whatever is impure or below the required temperature. A congregation does not have time to breathe the air of the room all over before the first supply is entirely removed and a fresh supply is poured in upon them.

There is no longer any need of cold feet or bad air in churches or public buildings. A service ten hours long, with a packed audience, with no opening of windows or doors or ventilators in the roof or walls, will leave the air as pure as it was fifteen minutes after the crowd came in. Isaac D. Smead & Co., of Toledo, O., will guarantee these things to any church, permitting the church to write the guarantee in any terms which its sharpest lawyer may select. Our experience already satisfies us that they will forfeit nothing on their guarantee to us.

Glen's Falls, N. Y., March 5. G. B. GOW.

REPORT OF THE COMMITTEE ON HEATING AND VENTILATION.

SCHOOL DISTRICT NO. 4, AURORA, ILLINOIS.

PRELIMINARY.

So much perversion, misstatement and misrepresentation has been indulged in concerning the introduction and trial in the West School District of two Smead Heaters, especially designed for school-room use, that the *facts* will be welcomed by candid minds.

The fuel bills of this school district were enormous, amounting, in winter previous to the past, to $597. The Ruttan Company, manufacturing at Bloomington, called the attention of the Board of Education to their school-room heater, and promised that they would work a very great saving in fuel, and proposed that two of them should be taken on trial for a winter, and that they would take them away and save the board harmless from all cost, in case their guarantees as to them were not fulfilled.

The board, by unanimous vote, determined to test them, and authorized the committee on heating and ventilation to place two of them in the school for trial, which was done, and in due course of time it became the duty of that committee to make report to the board concerning the workings of the stoves.

It is hoped that no taxpayer will fail to candidly peruse the report, and that no parent, who values the health and well-being of his children, will neglect to read it, to the end that just and unimpassioned information may obtain.

THE REPORT.

To the Board of Education, District No. 4.

The subject of heating and ventilating school buildings is the most important question with which boards of education have to deal. The sanitary condition of an apartment in which a teacher and 50 or 60 pupils are required to pass six hours per day, should be a matter of the greatest solicitude and concern. The branches taught, methods of instruction, and the efficiency of teachers, are matters of small moment in comparison, for no amount of knowledge absorbed by the mind can compensate for an impairment of the physical powers. Deprived of health, graces of mind and intellect but make sharper bodily suffering.

Comparatively easy is it to heat a given number of cubic feet of confined air, but to keep that air in a condition fit to be inhaled in a school room where a large number of children are constantly consuming the vital properties of the atmosphere, and at every breath making it more poisonous to the human system, rendered further impure by the exhalation from the pores of the skin, and the odor from apparel too often soiled, is more difficult, and seems to be a question of too little public concern.

It is the opinion of physicians, eminent in their profession, that very many diseases are caused almost entirely by the inhalation of a poisonous atmosphere. A well known practitioner in Chicago recently gave it as his opinion that the prevalence of scarlet fever among the public school children of that city was due to the want of ventilation. "Man's worst enemy is his own breath."

We have in this school district numbers of children that are prostrated from time to time by the foul air of our school rooms, so as to keep them from school for weeks together. A prominent physician said to one of your committee that he was unable to send his daughter to our school for that cause; while another gentleman, who has been honored as chief magistrate of our city, traces the cause of a fond daughter's death directly to her efforts to obtain an education in our unventilated school rooms, and a daughter of a clergyman is said to have died from a like cause.

In the opinion of your committee there is a remedy within our reach; there is no excuse for so barbaric a condition; it is criminal in us as a board not to recognize and afford a remedy for the evil.

That as a board we have done this, in a measure, will appear further on.

Ventilation should not depend upon the whim of a janitor or the caprice of a teacher, but it should be constant, automatic, self-working, to be of value.

The danger in a crowded room, from attempted ventilation from open windows, when the temperature is low out of doors, is scarcely less than from the inhalation of foul air, for where cold draughts are introduced into a room some of its occupants must seriously suffer. Quite recently complaint was made to one of your committee that a little girl in No. 4 had been made quite ill by a column of cold air striking her from a transom accustomed to be opened.

Actuated by a desire to do what was wise and judicious toward securing better air for our school rooms, this board, one year ago, authorized its committee upon heating and ventilation to place in the main school building, upon trial, two of Smead's Ventilating School-Room Heaters, using bituminous or soft coal as fuel; and it is the duty and pleasure of your committee to make report thereon:

1st—As to their capacity as heaters.

2d—As to their effectiveness as ventilators—their ability to keep up a constant and abundant supply of pure warm air.

3d—The cost of heating a school room with one of them, as compared with the ordinary anthracite or hard coal stoves in use in the other rooms of the same building.

The High School room, from its exposed situation, and by reason of its being much larger than any of the other rooms, has always been a difficult room to warm properly in cold weather, and the efforts of *two* hard coal stoves have been required therefor. It was thought that this room would afford a test of the heating capacity of any one stove, and here was placed one of the heaters on trial. *By repeated tests with thermometers, your committee demonstrated the fact, and to our surprise, that the room was warmed in every portion alike; that there were no cold corners.* How thoroughly they were warmed remains to be seen. * * * * * * * * * * * * * * * * *

It will be observed with satisfaction that No. 8, the High School room, the largest and most exposed room perhaps in the building, was warmed as thoroughly on this morning with *one* of the new heaters as smaller rooms were with two of the ordinary stoves. These tests your committee deem evidence *conclusive* as to their power and capacity. No unusual endeavor was made to produce these results.

Your committee will not discuss the advantage of necessary attendance upon one stove rather than upon two, or of the relief which is afforded to a school room by the absence of a second stove. The efficiency of these new heaters as ventilators can be best understood by an explanation of the principle upon which they operate. *They do not warm the cold air already in the room, but displace it, and inject warmed air into the room to take its place. A copious volume of pure fresh air from out of doors passes constantly in contact with the warm iron of the heater,* is warmed by the contaction, and then passes into the room, displacing through an exhaust next to the floor a corresponding volume of cold foul air. *In a recent trial directed by one of your committee, and made by the janitor, it was found that an entire change in the air of the High School room, containing* 13,800 *cubic feet, was effected in fifteen minutes.* In a second trial the same result was produced in twenty minutes. Your committee were hardly prepared to believe it could be accomplished so soon. That the heaters on trial are powerful as heaters, and that they ventilate effectually, is a conclusion which your committee cannot avoid. * *

Your committee has not been actuated by a determination to make a case for the new heaters, but has felt that a system of heating which promised to better guard the health of the pupils, and provide warmth and comfort where there is now chill and inquietude, was entitled to full consideration and fair trial, and to such report and commendation as might be warranted by the results obtained.

Your committee have the welfare of our school children very near at heart, and have a lively appreciation of the cold and discomfort which many of them have suffered in the past winter. In rooms 1 and 2 there have been many days in which it was cruelty to confine small children in apartments so cold as they have been, and the condition at the branch building has been but little better. To summarize, your committee find:

1st—That a heater like those on trial, has a heating capacity equal to, if not superior to, *two* stoves now in use.

2d—*That one of them produces an entire change in the atmosphere of one of our school rooms as often as once in twenty minutes.*

3d—*That there is a saving of forty-two per cent of fuel in their use.*

Respectfully submitted.

W. S. FRAZIER,
Chairman Committee Heating and Ventilation.

STOVE GASES.

WROUGHT-IRON VS. CAST-IRON AND CARBONIC OXIDE.

To the Editors of the Boston Daily Advertiser:

During the past four or five years much has been written and said in regard to the effects of cast-iron used in the construction of stoves and furnaces. Cast-iron, it has been said, allows poisonous gases (carbonic oxide, carburetted hydrogen, sulphur compounds, etc.) to pass freely through its pores, even at temperatures below redness. Wrought-iron was claimed to be free from this objection.

Certain experiments made under the direction of the French Academy have been quoted in proof of these statements, but have been so exaggerated, either by ignorance or from selfish motives, that there is a great misapprehension on the part of the public in regard to the real facts of the case.

Furnaces and stoves have been invented, claiming to obviate the difficulties alleged, and recently the matter was brought before a scientific body in this city, where the great dangers said to arise from the use of cast-iron were freely discussed.

These dangers have been greatly exaggerated and overrated. What are the facts? In 1863–64 Deville and Treost, at Paris, discovered that various metals—platinum, iron, etc.—were permeable to gases at a bright red heat; this permeability was only slight, for after several hours traces only of certain gases found their way through. Dr. Carrett, in 1865, and Gen. Morin, in 1868, brought their experiments to the notice of the French Academy, and suggested the appointing of a commission of scientific men to report upon the extent to which cast-iron stoves were detrimental to the public health. At the same time Gen. Morin presented the results of several experiments, upon which all of the cry against cast-iron has been based. These experiments were made with *soft coal* (which, as is well known, yields more gaseous products than anthracite,) and stoves of cast-iron *only one-tenth of an inch thick.* The stoves were heated to a red heat, yet in the concluding experiment, lasting twenty-seven hours, there was produced in the 250 liters of air in a close vessel surrounding the stoves about $\frac{4}{10\,0}$ of a liter of carbonic oxide, or only one part of this poisonous gas in 6,000 parts of the confined air. Had the gas produced in twenty-seven hours escaped into a room of 1,000 cubic feet capacity—a room without the slightest ventilation — there would have been found in 625,000 parts of air only one part of carbonic oxide. If such a room were ventilated, is it possible that the air at any given time would have been poisonous? Even this small quantity of carbonic oxide did not pass *through* the cast-iron, for by far the greater part of it was developed on its outer surface, as the subsequent report of the commission shows. A commission was appointed to fully investigate the matter. Among its members were Fremy, Payen, St. Clair, Deville and Gen. Morin, and after a series of experiments lasting more than a year, a full report was made. No one of those who have said so much against cast-iron seems to have given this report any notice. It is contained in the Comptes Rendus, May 3, 1869. After detailing at considerable length their various experiments and methods showing the production of carbonic oxide in small quantities, under certain circumstances, by stoves of either wrought or cast-iron, they report:

The results indicated above are produced *only when the metal is brought to a red heat.*

The most immediate effects are those due to the direct radiation of these surfaces, and in this respect *there is no difference between wrought and cast-iron.*

The report further shows that carbonic oxide is produced mainly by the following causes:

I. The direct action of the air upon the carbon in the iron heated to redness.
II. The decomposition of the carbonic acid in the air by its contact with the metal heated to redness.
III. The influence of dust and organic matters naturally contained in the air.

The commission further report that a development of carbonic oxide may take place from wrought-iron stoves brought to a red heat, and they close with the statement:

By lining stoves with fire-brick or clay all the inconveniences noted may be avoided.

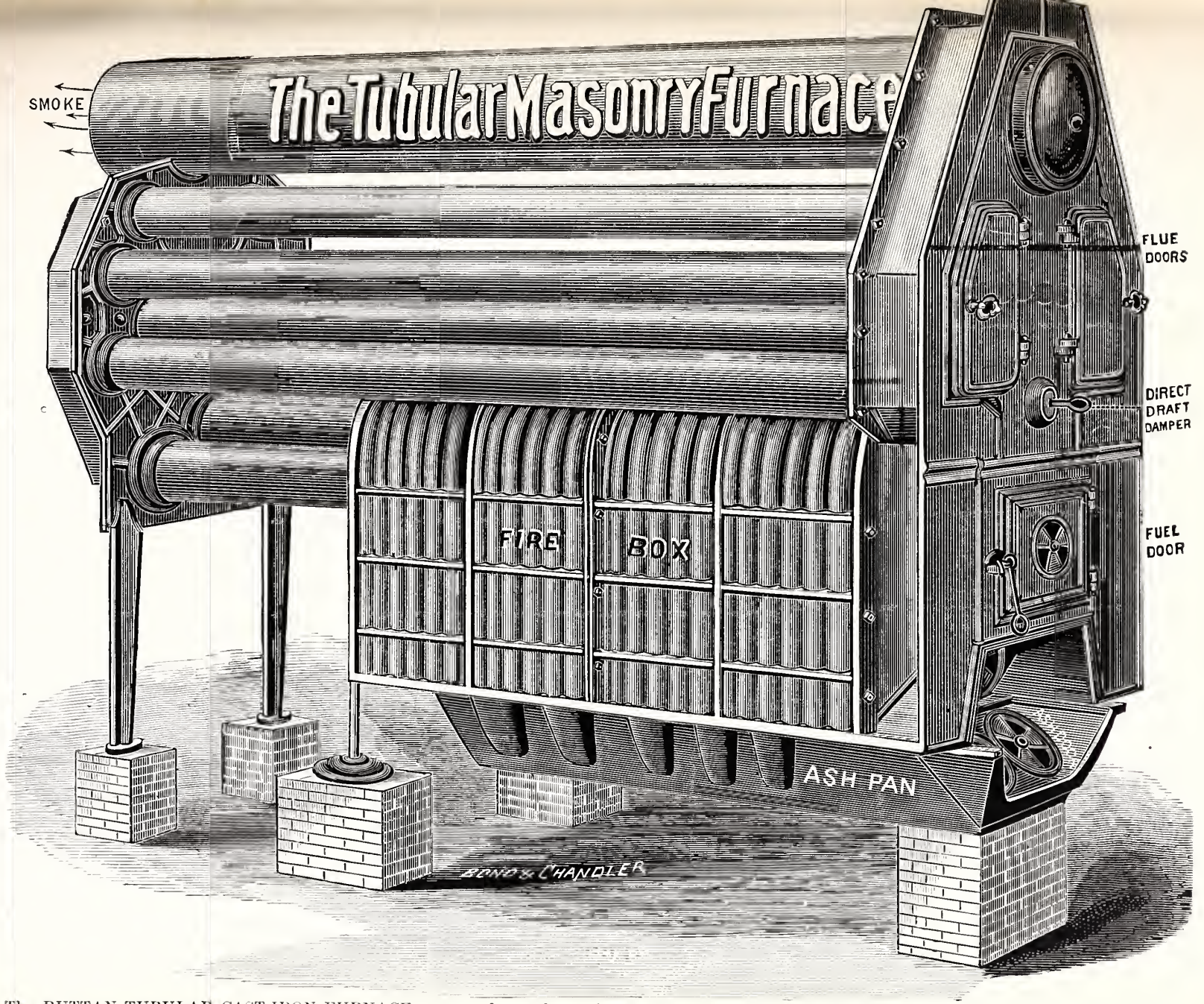
It is far from my purpose to underrate the great importance of having the air of our houses as pure as possible, and of avoiding the slightest presence of carbonic oxide or other dangerous gases, but it seems to me very wrong that sensational stories should be circulated in the name of science, and facts exaggerated, causing unnecessary alarm in regard to matters of great interest to the public.

Our stoves and furnaces too often emit dangerous gases, but it is not the cast-iron "permeated by these gases at every pore" that is at fault; it is the red-hot surfaces acting upon the air itself; the imperfect dampers; the dust in the air. Let us hope we may hear no more of this great scare about poisonous gases coming through the pores of cast-iron in a furnace an inch thick. Respectfully,

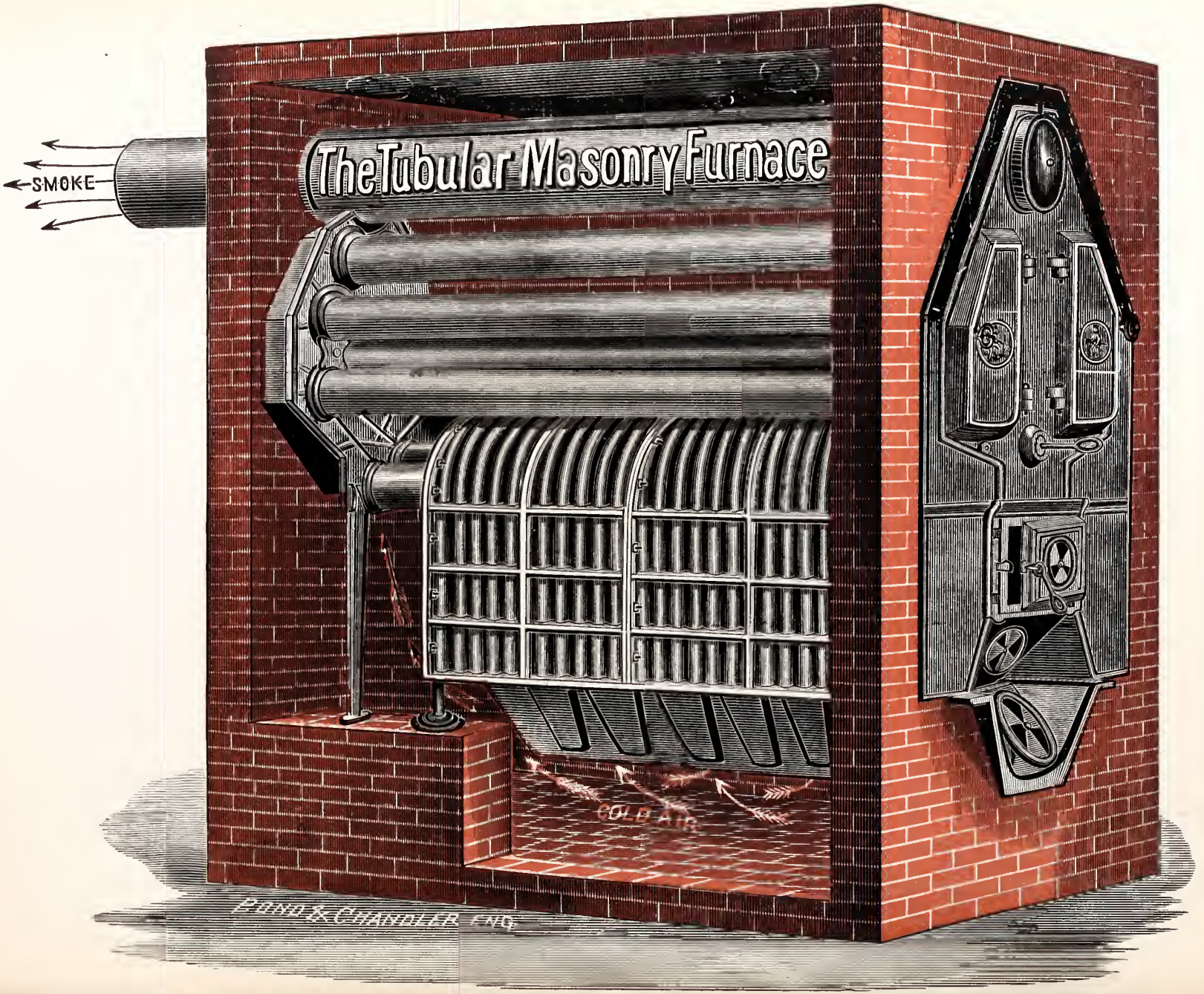
No. 8 Boylston St., Boston, June 6. James F. Babcock.

OPINION OF A WELL KNOWN SCIENTIST.

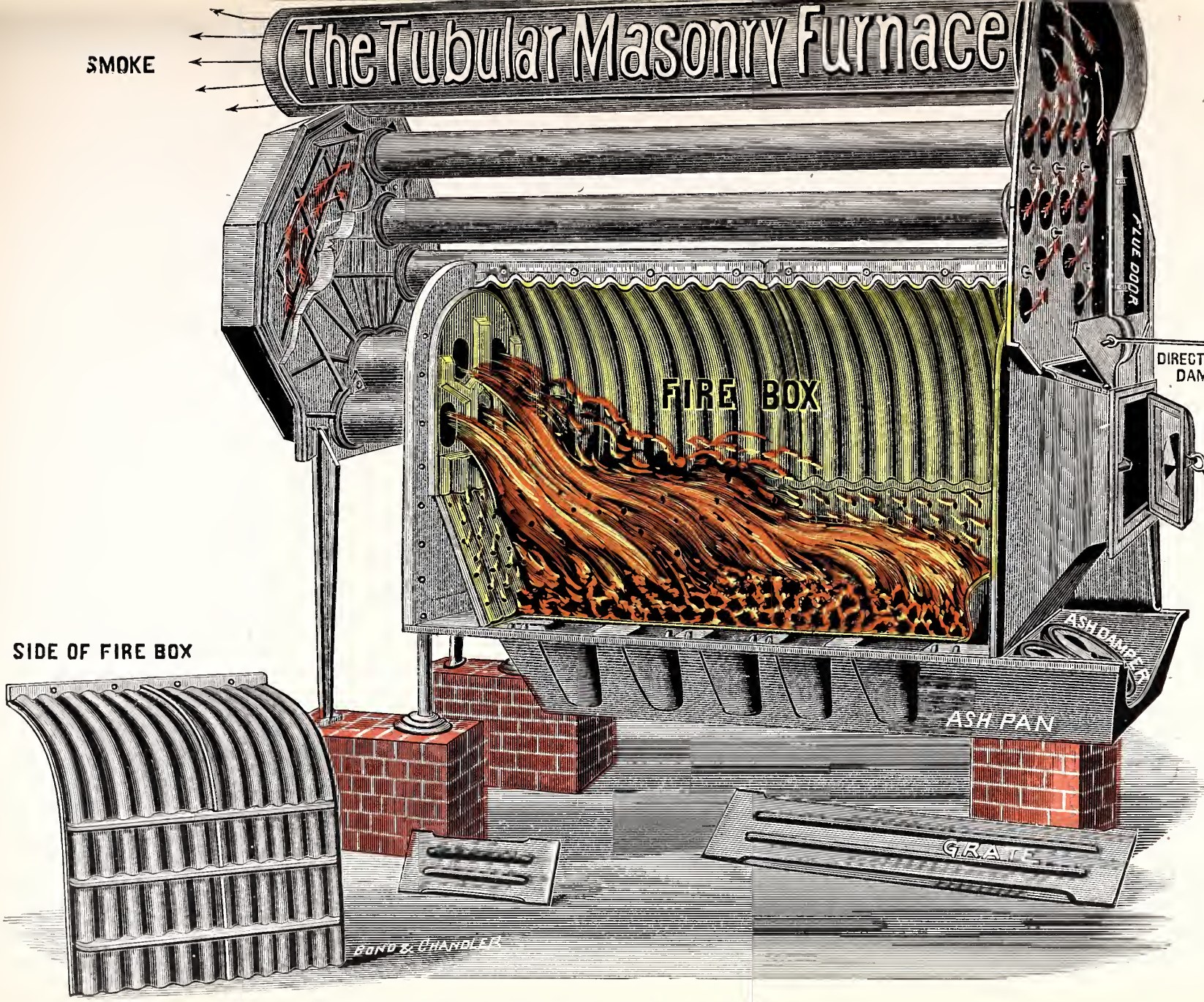
Prof. Kedzie, of the Michigan Board of Health, contradicts the notion that has been so industriously circulated of late years that gas will not escape through the walls of wrought-iron furnaces. It will not penetrate them as readily as cast-iron, but will pass through if highly heated. Cast-iron furnaces are good enough if large enough, so as to furnish sufficient warmth without being overheated, if the joints are well closed with cement, and if no dampers are allowed in the pipe to obstruct the passage of the gas into the chimney. Moreover, cast-iron radiates heat better than wrought-iron.



The RUTTAN TUBULAR CAST-IRON FURNACE, as manufactured previous to 1885. The above is a correct representation of the Ruttan Tubular Masonry Furnace, as shown before brick case is put around it. Our No. 7 is 10 feet long, 6 feet high, and 3½ feet wide, and weighs about 5,000 pounds.



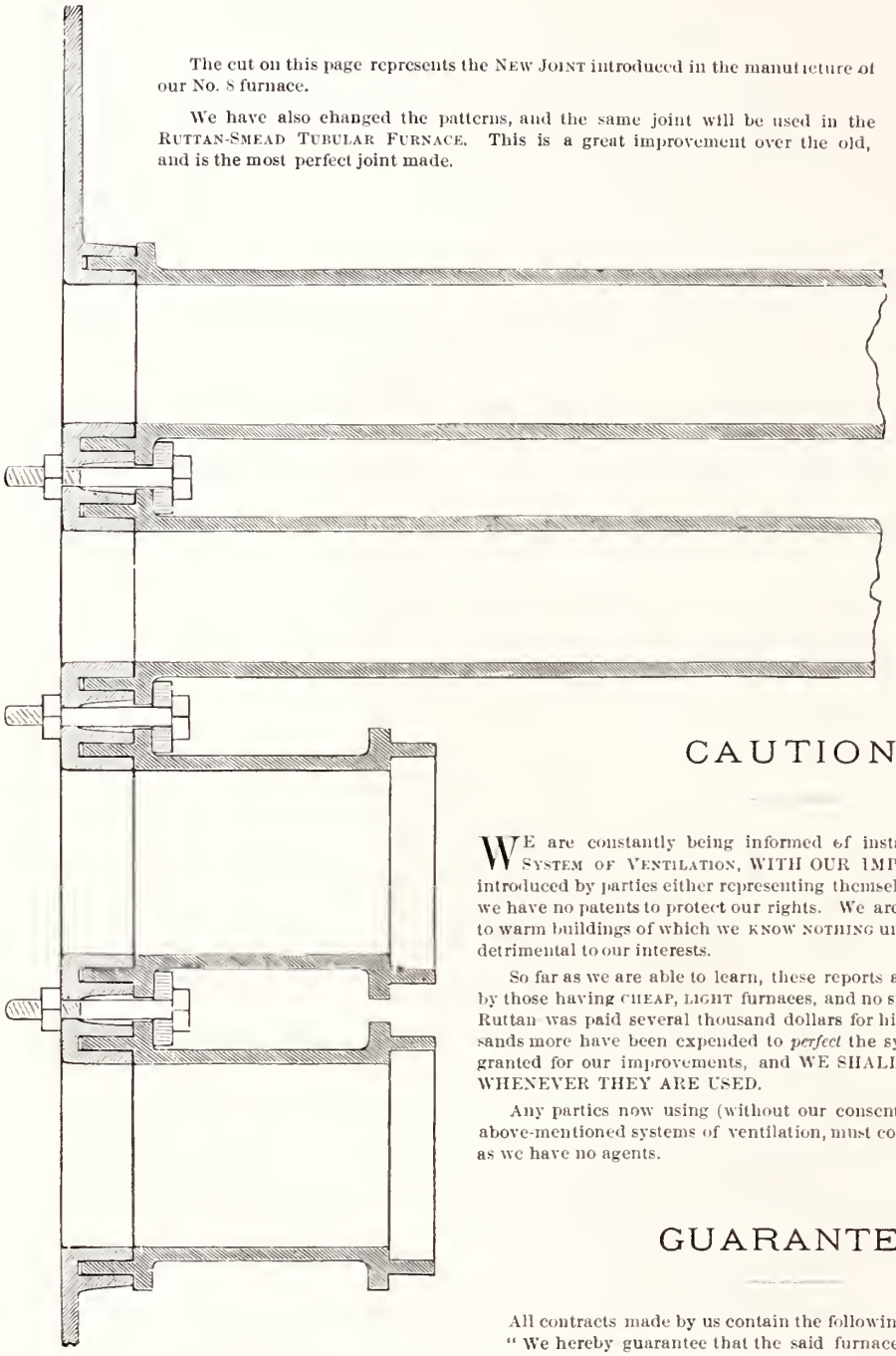
THE TUBULAR CAST-IRON MASONRY FURNACE, WITH BRICK CASE ON FRONT, REAR, TOP AND ONE SIDE.—Seven sizes.



INTERIOR VIEW OF THE TUBULAR MASONRY FURNACE—Seven Sizes.

The cut on this page represents the NEW JOINT introduced in the manufacture of our No. 8 furnace.

We have also changed the patterns, and the same joint will be used in the RUTTAN-SMEAD TUBULAR FURNACE. This is a great improvement over the old, and is the most perfect joint made.



CAUTION.

WE are constantly being informed of instances where the RUTTAN SYSTEM OF VENTILATION, WITH OUR IMPROVEMENTS, has been introduced by parties either representing themselves as our agents, or that we have no patents to protect our rights. We are charged with the failure to warm buildings of which we KNOW NOTHING until we hear the reports so detrimental to our interests.

So far as we are able to learn, these reports are started and circulated by those having CHEAP, LIGHT furnaces, and no system of ventilation. Mr. Ruttan was paid several thousand dollars for his patents, and many thousands more have been expended to *perfect* the system. Patents have been granted for our improvements, and WE SHALL COLLECT A ROYALTY WHENEVER THEY ARE USED.

Any parties now using (without our consent), or desiring to use, the above-mentioned systems of ventilation, must correspond directly with us as we have no agents.

GUARANTEE.

All contracts made by us contain the following guarantee, to wit:

"We hereby guarantee that the said furnace(s) shall, with good care warm the..... .....rooms of said building to an average temperature of from 65° to 70° Fahrenheit during the *coldest weather*, and at the same time secure good ventilation in all rooms warmed. Provided the furnace(s) do(es) not fill the above guarantee, we agree to refund all money paid us, also money paid for freight and mason work, and remove the furnace(s) from the building."

TO SCHOOL DIRECTORS.

IF you are intending to buy warming and ventilating apparatus for new or old buildings, it will pay you to correspond with us before buying elsewhere. When desired, we will send an expert to examine buildings and make plans and estimates free of charge. Our specialty, above everything else, is **Warming and Ventilating School Buildings,** of which our firms do **more than any other** five firms in this country. When a new building is to be erected do not delay the decision of how you will warm and ventilate it until contracts for building are let. Changes may be necessary and expensive.

Please notice in the foregoing pages, that the class of school buildings in which our work is to be found, is unsurpassed in this or any other nation of the world. This is unquestionably true; and the system of warming and ventilating is worthy of the buildings. Where Boards of Education are desirous of investigating our system, we are ever happy to take them to various cities where our work is in use, and explain its actual working to them in every way. It is always more satisfactory to our customers and ourselves. They will then understand how much larger, heavier and more durable our apparatus is than **any other.** It is especially desired, on our part, that members of Boards go with us and **fully examine our Dry Closet System.**

If the ventilation of any of your buildings is not good, we shall be glad to correspond with you concerning the matter. Inquiries regarding any of these matters will receive prompt attention. Connected with each office are experts who have made warming and ventilating their study for many years. Our system and methods are uniform throughout our various houses, and an opinion on these points from any one of them, after a careful examination of the building, or the plans, we believe will be found as nearly correct as can be obtained. **It is our sole business.** We do not claim to be architects or doctors, but we do claim that we can design a plan that will take out the impure air and supply your buildings with pure, fresh air, warmed to a proper temperature. No firm in America can show work **equal** in quality to that done by any of our Ruttan Companies: Ruttan Manufacturing Co., Chicago; Ruttan Ventilating and Heating Co., Kansas City; Ruttan-Smead Heating and Ventilating Co., Toledo; and Ruttan-Smead Warming and Ventilating Co., Elmira, N. Y.

Remember that our Ruttan System of Ventilation is the only thoroughly successful one in use, and that it is rapidly taking the place of all others; and remember that the **Ruttan-Smead Tubular Furnaces** are very much heavier and more durable than any other in the market, their weight being from one thousand five hundred pounds to **five thousand eight hundred pounds each.**

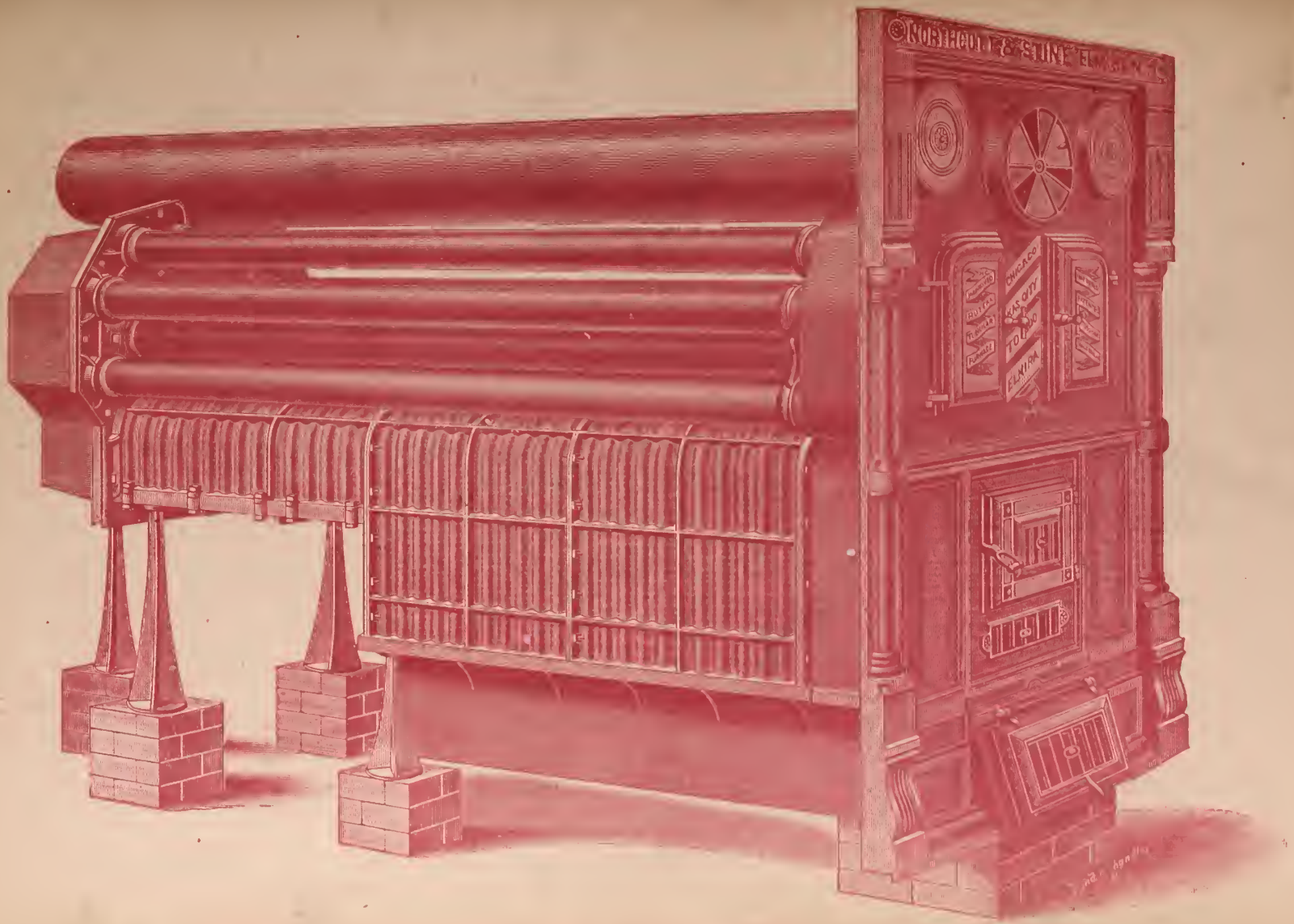
Ours is not a "hot air" apparatus. We take into the rooms a large volume of moderately warmed air, instead of a small quantity intensely heated.

Our apparatus is largely used in **churches, court houses, jails, insane asylums, alms houses, opera houses, store buildings and dwellings.** We will always, when it is desired, send a reference list on any of our work, so that inquiry may be made of parties having our apparatus in use. Trusting that you have found points of interest in reading the foregoing pages, and that it may lead to further investigation and to correspondence with us, we are,

Very respectfully yours,

NORTHCOTT & STINE,

ELMIRA, N. Y.



EXTERIOR VIEW OF RUTTAN-SMEAD TUBULAR AIR WARMER.

(1886 Pattern.)

The largest size is thirteen feet long, six feet high, five feet wide, and weighs about *three tons.* (For description, see pages 5, 16 and 20.)